SCIENTIFIC AMERICAN

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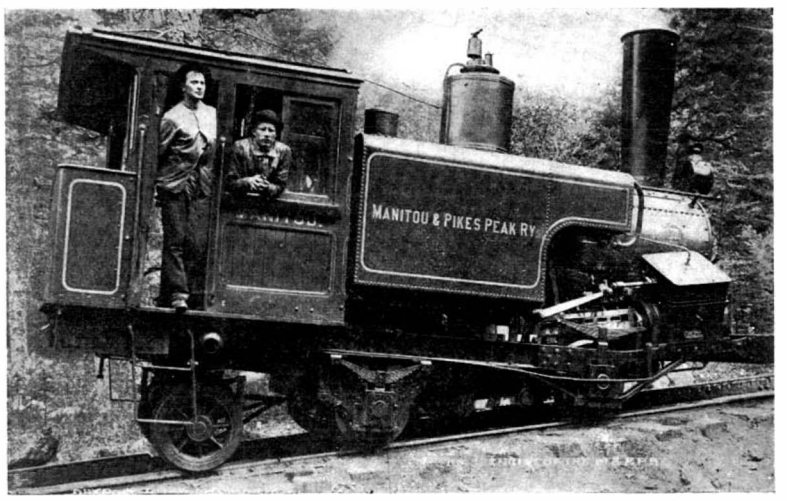
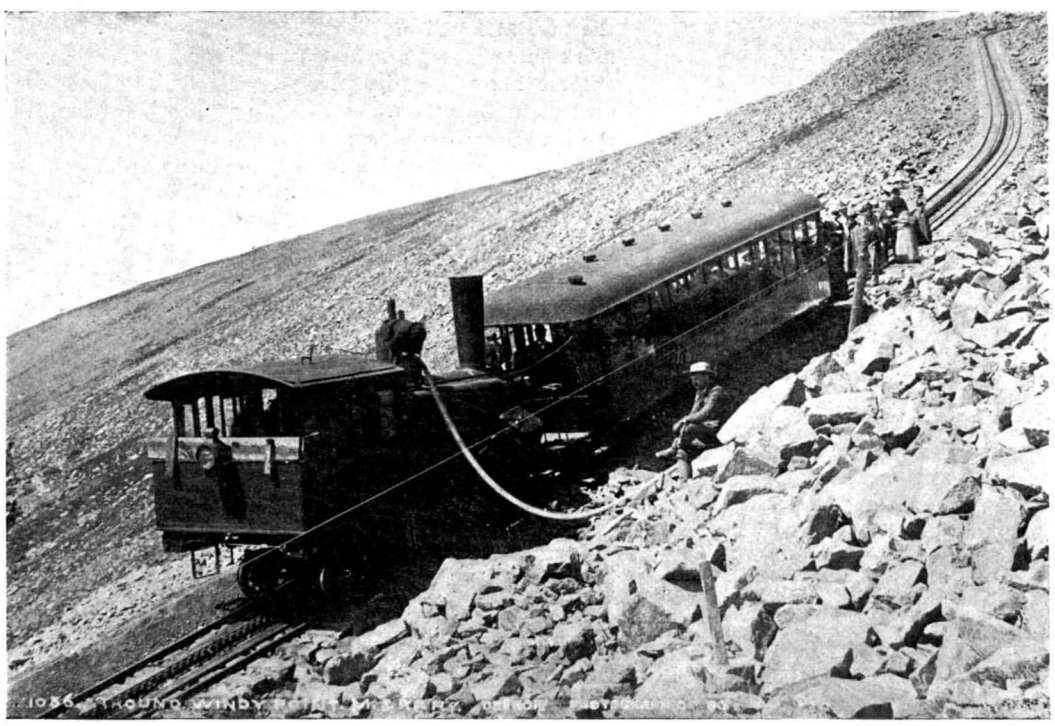
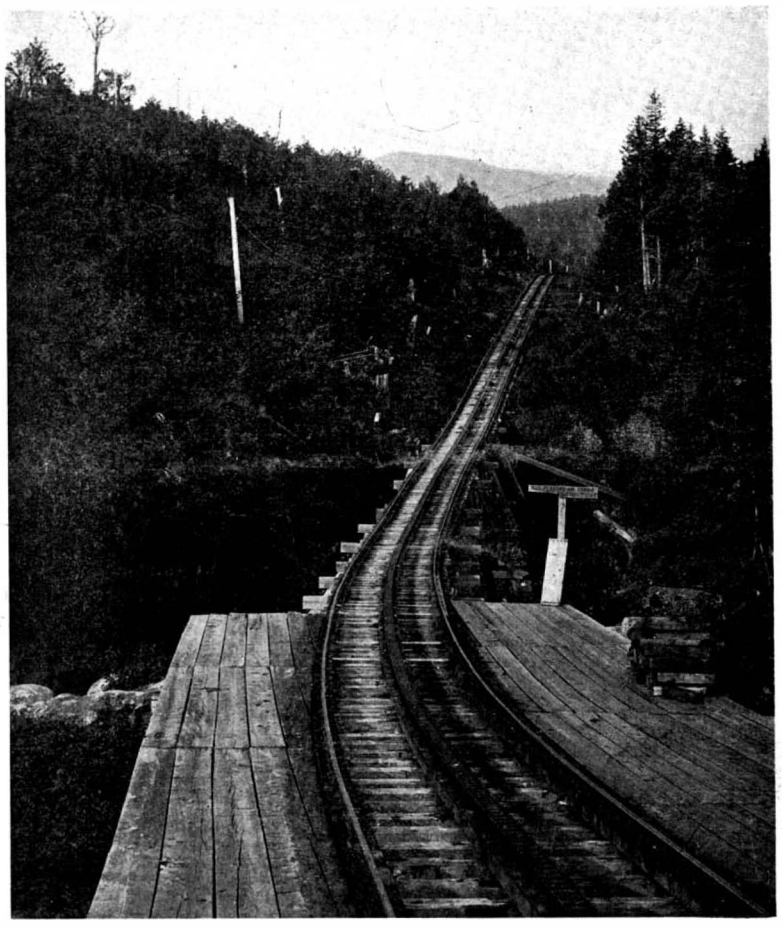
Around Windy Point—Manitou and Pike's Peak Railway.



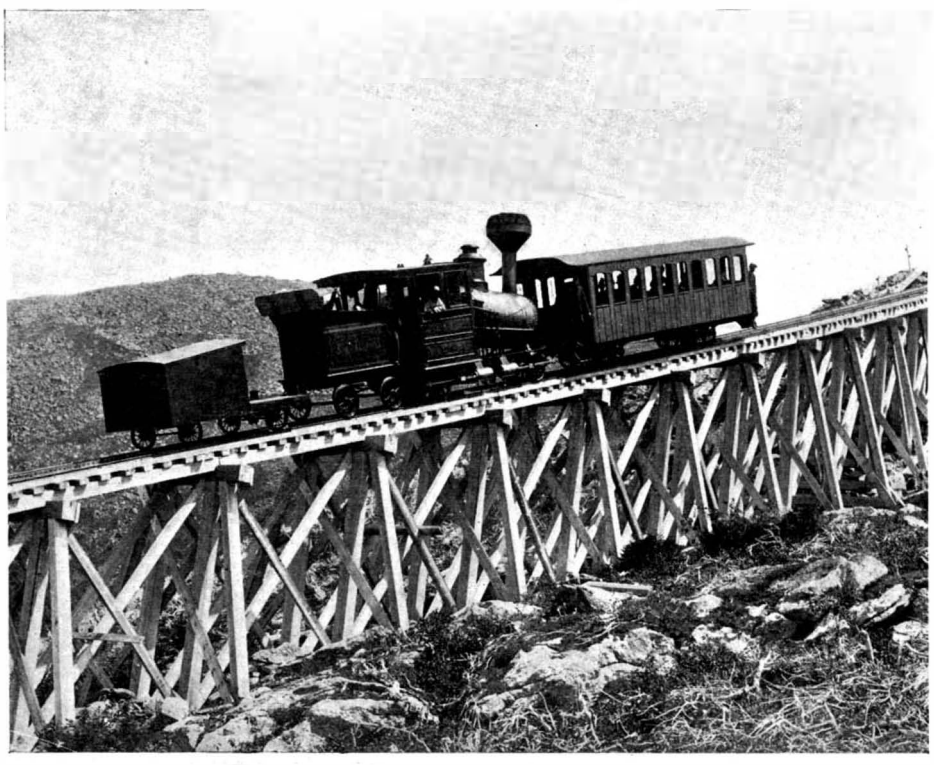
Engine, Manitou and Pike's Peak Railway.



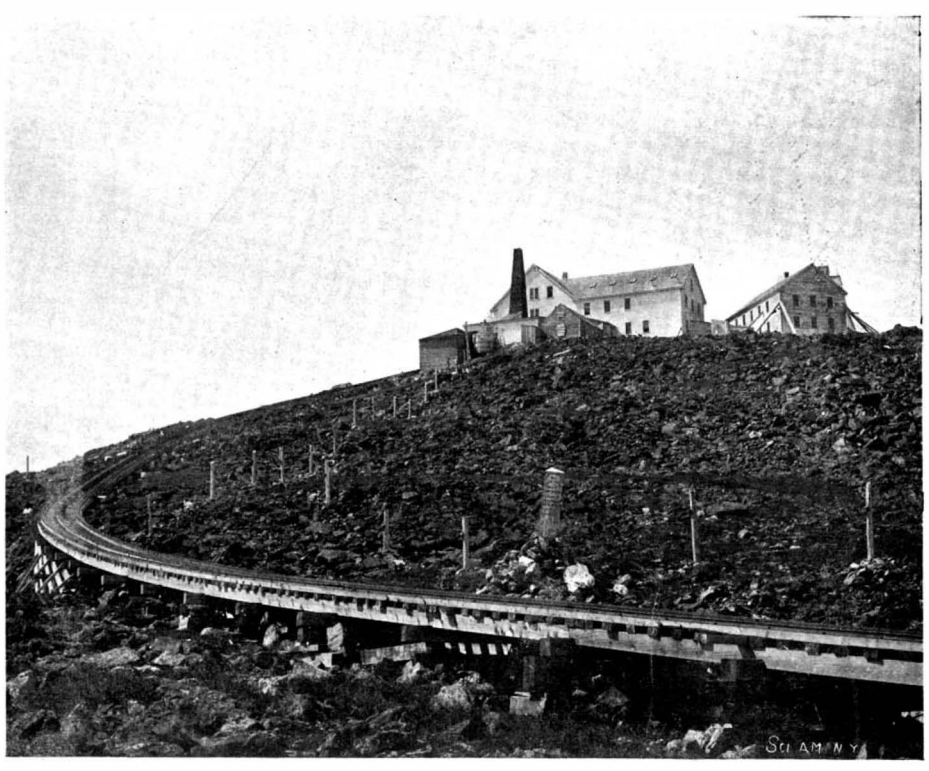
Taking in Water, Windy Point—Manitou and Pike's Peak Railway.



Steep Incline, Mount Washington Rack Railway.



"Jacob's Ladder"—Mount Washington Railway.



Summit House, Mount Washington.

THE STEEPEST RAILWAYS IN THE UNITED STATES.—[See page 70.]

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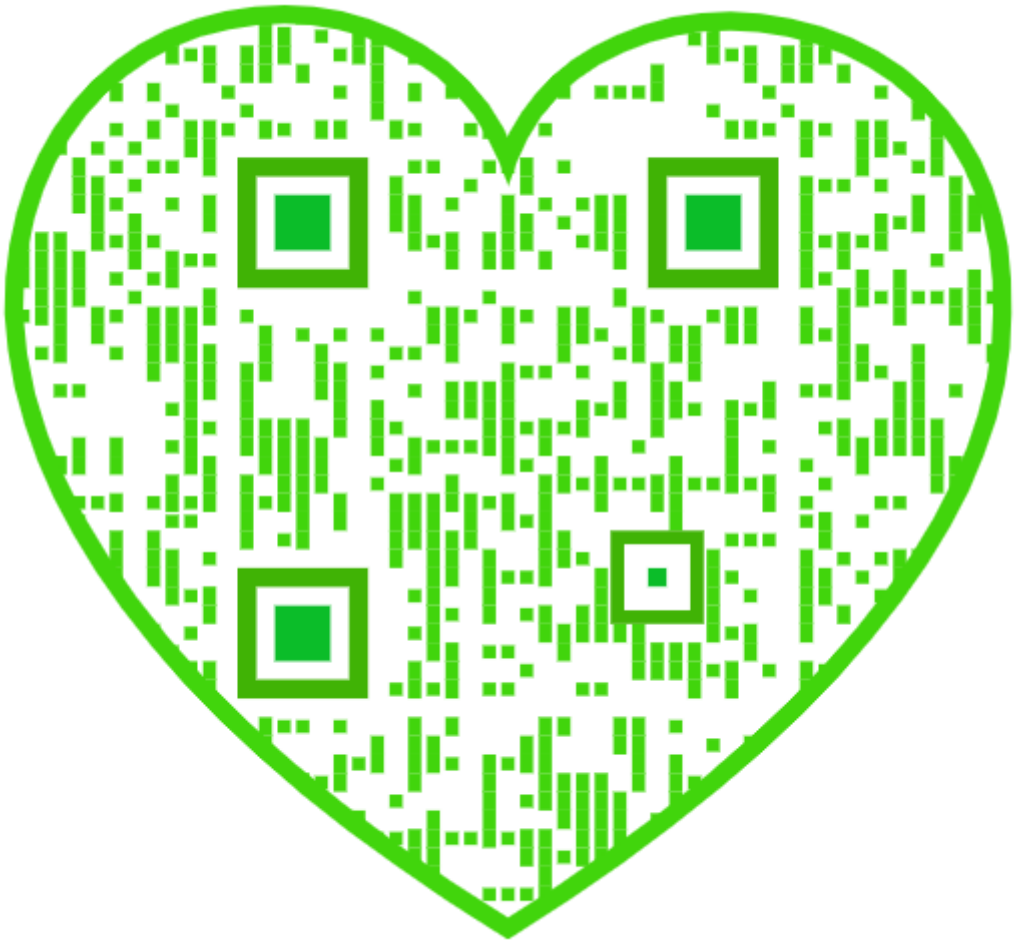

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NEW YORK, SATURDAY, FEBRUARY 2, 1901.

VICTORIA.

As a journal devoted to the interests of the arts and sciences, we offer our tribute of respect to the august sovereign, whose reign of three score and three years, just closed, has witnessed an advancement of mankind in the arts of peace for which there is no parallel in the history of the world.

How far the manifold virtues of the Queen conduced to the industrial pre-eminence of the people over whom she ruled—a pre-eminence which is only now being challenged—is a matter for conjecture; but if, as some affirm, the stability of a nation is to be measured by the purity and strength of its home life, we may well believe that to this noble lady who was at once a model mother, wife, widow and Queen, much of England's greatness is due.

In an age which is, or is supposed to be, less sympathetic and more cynical than any that preceded it, there is something profoundly reassuring in the universal wave of regret that swept around the world with the tidings of her death; for, in the instantaneous and unsolicited display of sympathy that broke forth, as in this city, in a thousand half-masted flags, we see the impulsive tribute of this twentieth century world to a lady who, amid the unbounded opportunities for display and self-aggrandizement that surrounded her throughout the sixty-three long years of her reign, preferred always to be queenly among women rather than queenly among queens. Yet she was both; and it is in the happy commingling of her public and private virtues that she has won the love of her people and the profoundest respect of the civilized world.

THE NAVAL BILL.

The bill which has just been reported by the House Committee on Naval Affairs is considerably the largest that has ever come up for the consideration of Congress; and yet, great as is the total, it is certain that every dollar of the money asked for is required, if our navy is to keep pace with its ever multiplying and widely extending duties. The annual appropriation bill reaches about $80,000,000 and even this great sum does not include the new ships which are contemplated in this year's programme of construction. Four vessels of the first class are asked for two of them to be battleships whose cost, exclusive of armor and armament, is put down at $3,850,000 each, and the other two are to be armored cruisers of 14,000 tons displacement, which are to cost, exclusive of armor and guns, about $4,000,000 each. The total cost of these vessels, $15,700,000, is not reckoned in the appropriation bill, however and if this sum be included the total amount required reaches about $95,000,000.

The $80,000,000 are to be devoted to the work of bringing up, not merely our existing ships, but the dock yards and building and repair plants on shore, to that high standard which is necessary, if our navy is to be at all times in a position of proper efficiency. As a matter of fact, our equipment on sea has developed in recent years far more rapidly than our equipment on land. The navy needs dry docks, repair plants, coaling depots, naval magazines, and supplies of ammunition, besides a thorough overhauling of the battleships and cruisers, docks, and machine shops which have already seen longer or shorter periods of service. Twenty-five millions are called for under the head of construction and repair, while $11,000,000 are to be devoted to the naval stations, docks, and navy yards throughout the country Coaling stations and dry docks do not appeal to the popular imagination, nor make as brave a spectacular show as battleships and cruisers, but to the naval strategist it is known that upon their existence may depend the issues of a naval war and the life of a maritime nation.

YACHT RACING AND THE TOWING TANK.

For reasons which are to be sought on both sides of the Atlantic, the international yacht races of 1901 promise to have a special interest. Not since the year 1893, when there were no less than four yachts, each of a distinct type constructed for the defense of the cup, has there been a contest in which America was represented in the preparatory trials by more than one new yacht. The "Defender" was the only boat built specially for the contest in 1895, and in 1899 "Columbia" was the solitary champion. This year the defending yacht will be selected from two, and possibly from three, competitors, two of these being out-and-out, fin-keel boats, and the third, if it should ever be built, being a typical American centerboard, broad and shallow.

English yachtsmen will content themselves, as usual, with a single representative, the formidable task of defeating the best this country can design and build being intrusted this time to a designer, Mr. Watson, who more than any other has been identified with the English attempts to win back the "America" cup. The distinctive characteristics of Mr. Watson's boats are pretty well known on both sides of the water; but particular interest attaches to the new yacht, from the fact that it is being built at the well-known Denny yard on the Clyde, and that Watson has availed himself of the opportunity thus afforded for making use of the invaluable services of the towing tank in designing the hull of the new challenger, which, by the way, is to be known as "Shamrock II."

It has long been a matter of surprise to naval men that yacht designers have not sought to obtain the valuable data which could be secured by testing exact models of their yachts in the towing basin. So accurate are the results obtained with the models of battleships and cruisers, that it is possible to predetermine how much horse power will be necessary to drive a ship at any given speed, by the simple expedient of towing a model of the same at a given rate of speed through the water, and noting the pull on the towing line. Of course, the problem would be complicated in the case of a yacht. Unlike a warship, she is always sailing at a greater or less angle of heel, and consequently the form of her immersed portion is constantly changing. This complication of the problem makes the peculiar value of towing tank experiments all the more apparent. A form of hull which is easy to drive under a small angle of heel may drag heavily under a larger angle, a fact which was proved in the case of "Valkyrie III." and of "Shamrock." Both of these vessels held their own fairly well with the American yachts in light airs; but they were quite unable to compete with them when the course was sailed in a heavy breeze, and the yachts were borne down until lee-rails were awash. Some peculiarity in the modeling of the run and quarters of the English challenging yachts has caused them to roll up a quartering wave, that acted as a heavy drag when the speed ran up to 12 or 13 knots an hour. Thus, "Valkyrie III." drew rapidly away from "Britannia" and "Ailsa" in the light airs that prevailed in her earlier trials on the Clyde; but in the strong wholesail breeze of her third race, when the lee scuppers were awash, she pulled after her a quartering wave whose magnitude is easily seen in the well-known photographs representing this eventful race, in which, by the way, she was easily beaten by the three-year-old "Britannia." The same defect was seen in "Shamrock" in her third race for the cup, when, in spite of the assistance of a huge club-topsail, she fell steadily behind the cleanly-modeled "Columbia," although this beautiful craft had doused her topsail and was sailing under easy canvas.

Whether the towing tank will enable Watson to determine why it is that his boats, which are superb in windward work, are invariably so poor in reaching in a strong breeze, is a question which will best be answered off Sandy Hook next summer. By careening the models to the angle of heel which they would assume in a strong breeze, and by adding weight as an equivalent to the vertical component of the wind pressure, it will be possible to produce conditions practically identical to those which occur in a race; and it ought not to take very long to discover what combination of run and quarters will give the least disturbed wake and the smallest stern wave, consistent with the maximum amount of sail-carrying power. If Watson is thus enabled to produce a yacht that is as good in running and reaching as his vessels have always been in windward work, we may look for a closer contest than we have witnessed in recent years.

THE IMPORTANCE OF REGISTERING TRADE MARKS

We have from time to time called the attention of our readers to the importance of registering their trade marks in any foreign countries with which they may be carrying on export trade. It is not thoroughly understood that in many foreign countries the first applicant receives the right of using the mark, although he may not have originated the same and may not be the rightful owner. The hardship which arises from such instances is very great and cannot be too fully understood by our manufacturers who are now engaged in export trade. The following cases have been reported by the United States Consul at Berlin:

"For several years past the Griffin Manufacturing Company, of New York, has been selling to the German trade through its agents—a German firm in Hamburg—a polishing paste for leather, each box of which bore its duly registered American trade-mark, viz., a "griffin," the fabulous antique monster, with the body of a lion and the head and wings of an eagle. As the Hamburg agents neglected to register this trade-mark in Germany, a certain maker of varnishes and similar goods in Berlin did so in his own name, and then, in April last, warned the Hamburg firm that they must not handle or sell in Germany any more goods bearing the griffin trade-mark without first purchasing his right to do so. As proceedings were threatened to enforce this mandate, the manufacturers in America, not choosing to submit to what they considered a species of blackmail, sought to avoid further complications by devising a new trade-mark for their goods intended for Germany, in which the picture of the animal was omitted and a device substituted consisting of a capital "G" with the legend "Mfg. Co." printed on a scroll across the letter, the whole showing that the preparation was made by the "Griffin Manufacturing Company," of New York. Thereupon the Berlin claimant returned to the attack, declaring that he had obtained exclusive legal right to the word "griffin," and threatening proceedings if any further goods were sold under the name of the Griffin Manufacturing Company. This latter claim is probably untenable, as article 13 of the German statute for the protection of trade-marks clearly proves that no person can be prevented from using his name, the name of his firm, his place of business, etc., either in full or abridged form on his products or on the wrappings or packages which cover or contain the same.

The second instance is technically similar but morally somewhat less aggressive, as the claimant acted under different antecedent conditions. This was a case in which a merchant in Berlin who had several years ago imported, advertised, and introduced a certain American fruit sirup found that it was being imported and sold by other dealers, and sought to obtain from the makers the exclusive handling of their product for the trade in this country. This being refused, he had the special name of the sirup registered as a trade-mark under the German law, and sought thereby to enforce his claim to exclusive control of its sale to dealers in this country, or, failing in this, to compel the American manufacturers to purchase his claim to their trade-mark. This he felt justified in doing for the reason that he had been instrumental in introducing their product in what had proved a profitable and permanent market.

All these complications may be avoided if Americans or other exporters who seek to introduce into Germany goods protected at home by a trade-mark will first register such trade mark in Berlin."

ELECTROLYTIC PREPARATION OF PHOSPHORUS.

A new apparatus for the electrolytic preparation of phosphorus has been recently patented in Germany. The apparatus generally used for this purpose have certain disadvantages, one of these being that it is necessary to take out the residues and give a thorough cleaning before operating upon fresh quantities of the material to be treated; such are the Parker, Robinson and Readman, the apparatus most used at present. In these, pure phosphate or a mixture of phosphate and sand or carbon is used, and the results are on the whole satisfactory; they present, however, the disadvantage already mentioned. The Dile apparatus, on the contrary, is claimed by the inventors to work continuously, and requires no other manipulation than that of introducing a fresh quantity of material after each is exhausted; phosphoric acid mixed with coke or charcoal is used in this case. The residue of the process is insignificant, and it gives a considerable economy of energy and of material used and the results are claimed to be more satisfactory. The apparatus is quite simple in its construction. It is composed essentially of a cylindrical recipient provided with an opening through which passes the negative carbon; at the top is also a funnel-shaped opening for introducing the material. The bottom of the cylinder is formed by a positive electrode of carbon. The negative electrode is supported at the end of a rod which is threaded and has a handwheel at the exterior so that the carbon may be raised or lowered to place it at the proper distance from the bottom. In ordinary cases the phosphoric acid has a concentration of 60 deg. to 70 deg. Baumé; it is mixed with one-fourth or one fifth of its weight of carbon in rough powder and the whole is introduced while hot into the apparatus. The current used depends upon the capacity of the apparatus and the arrangement of the electrodes. The electromotive force used is about 120 volts, with a current of 80 to 150 amperes. As soon as the greater part of the phosphoric acid is decomposed, the current is interrupted for an instant, and a portion of the mixture is introduced. The preparation then continues and so on indefinitely, without taking out the residues or cleaning the apparatus at frequent intervals.

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THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The chief event of last month was one relating to one of our nearest neighbors in space, and yet most inconspicuous to the eye—the close approach of the asteroid Eros to the earth. Another of our celestial associates plays the leading part in this month's drama, but the spectacle which he offers is far more brilliant, though less unusual, for the actor is the war-like planet Mars.

His opposition, which occurs on the 21st, affords the best chance of the year to observe him; but one which must nevertheless be counted unfavorable when compared with those of other years. The reason for this is that at the present time he is in that part of his orbit which is farthest from the sun, so that his distance from that body is nearly 155 million miles, though on the average it is 141½ million. The earth is at the same time about 92 million miles from the sun, so that Mars is no less than 63 million miles away from us. When, on the other hand, an opposition occurs when Mars is nearest the sun, his distance from it is but a little over 128 million miles, and that of the earth (whose orbit is a little farther from the sun on this side) is over 93 million, so that the gap intervening between the two planets is but 35 million miles across.

It is, therefore, easy to see why Mars is much more favorably placed for observation at such an opposition than at the present one. He appears nearly twice as large with the same telescopic power, and in consequence much more detail can be made out on his disk. To the naked eye the disparity is even more striking, for the amount of light that Mars sends us varies as his apparent area, and when he is nearest the sun he is moreover most brightly illuminated by it. The combined effect of these two causes is that at his most favorable opposition he is nearly five times as bright as at the least favorable, being almost equal to Jupiter in the former case, and, by no means, rivaling Sirius in the latter.

At conjunction, when Mars and the earth are on opposite sides of the sun, he is only about 1-12 as bright as at the worst opposition, and appears about equal to the pole star.

Oppositions of Mars occur at intervals of a little more than two years. This interval is longer than in the case of the more remote planets, since Mars moves faster and, therefore, it takes the earth longer to overtake him. The favorable oppositions occur at intervals of 15 or 17 years. The last one was in 1892, and the next will occur in 1909.

On this present occasion things are about as bad as possible, for Mars reaches his greatest distance from the sun on the 24th, only three days after opposition. Nevertheless he will be, in all probability, assiduously observed, in the hope that something may be seen which will add to our knowledge of his surface.

The possessor of a small telescope can reasonably hope to see the dark greenish markings which are usually supposed to be oceans, and the white spots at the poles, which, since they decrease in size during the summer of the hemisphere in which they lie, and regain their full dimensions during the winter, are supposed to be ice-caps. By watching the planet for a couple of hours the motion of the surface markings across the disk caused by its rotation can be clearly seen. The two satellites, which are the smallest bodies in the solar system, can only be seen with a large telescope, and the same statement holds true with even greater force with regard to the much-discussed "canals," some theories of whose nature we hope to consider next month.

THE HEAVENS.

The southern skies present a magnificent spectacle at our chosen hour of observation, 9 P. M., on February 15.

Right overhead, and a little west of the zenith, is Capella, which forms an irregular pentagon with the other principal stars of Auriga. Below and to the right is Taurus, marked by Aldebaran and the Pleiades. Orion is farther down on the left, and the small constellations of Lepus and Columba are between it and the horizon.

Beginning again high up, but farther to the left, we first reach Castor and Pollux, then Procyon, on a level with Orion, and lower down the incomparable Sirius. Below Sirius, to the right, is an irregular cross of bright stars which marks the hindquarters of Canis Major, and about as far again in the same line, and close to the horizon, is the star Zeta Puppis, which Sir Norman Lockyer believes to be much hotter than any other whose spectrum has been examined.

Those who live south of the latitude of Washington may, if the air is clear, catch a glimpse low down on the horizon, under Sirius, of the brilliant Canopus, which stands second to it in brightness among the fixed stars, but it is so far south that it never rises above the horizon of New York The most conspicuous constellations in the western sky are Perseus and Cassiopeia in the Milky Way, Aries and Andromeda below them, and Cetus in the southwest. In the east Leo is almost half way up the sky, bearing Mars with him. Ursa Major is conspicuous between Leo and the pole, and below the Lion the serpent Hydra stretches its ungainly length along the southern sky.

THE PLANETS.

Mercury is evening star for the whole of the month. He is best placed for observation on the 19th, when he is in his greatest eastern elongation, and sets nearly two hours later than the sun. He is unusually bright, and the present opportunity for seeing him in the evening is the best of the year. Venus is morning star in Sagittarius and Capricornus. She rises little more than an hour before the sun, and is becoming inconspicuous. Mars comes to opposition on the 21st, as has been already described, and is visible all night. Jupiter, Saturn, and Uranus are all morning stars. In the middle of the month they rise 3½, 3, and 4½ hours respectively before sunrise. Neptune is in Taurus, near the border of Gemini.

THE MOON.

Full moon occurs on the forenoon of the 3d, last quarter near noon on the 11th, new moon on the night of the 18th, and first quarter on the afternoon of the 25th. The moon is farthest from the earth on the 8th and nearest on the 20th. She passes Mars on the afternoon of the 5th, Neptune near noon on the 13th, Jupiter on the night of the 14th, Saturn the next afternoon, Venus on the afternoon of the 17th, Mercury on the morning of the 20th, and Neptune on the night of the 26th.

TESLA'S WIRELESS LIGHT.

Nikola Tesla has given to The New York Sun an authorized statement concerning his new experiments on the production of light without the aid of wires. Mr. Tesla says:

"This light is the result of continuous efforts since my early experimental demonstrations before scientific societies here and abroad. In order to make it suitable for commercial use, I had to overcome great difficulties. One of these was to produce from ordinary currents of supply electrical oscillations of enormous rapidity in a simple and economical manner. This, I am glad to say, I have now accomplished, and the results show that with this new form of light a higher economy is practicable than with the present illuminants. The light offers, besides, many specific advantages, not the least of which is found in its hygienic properties. It is, I believe, the closest approach to daylight which has yet been reached from any artificial source.

"The lamps are glass tubes which may be bent in any ornamental way. I most generally use a rectangular spiral, containing about twenty to twenty-five feet of tubing making some twelve to fourteen convolutions. The total illuminating surface of a lamp is from 300 to 400 square inches. The ends of the spiral tube are covered with a metallic coating, and provided with hooks for hanging the lamp on the terminals of the source of oscillations. The tube contains gases rarefied to a certain degree, determined in the course of long experimentation as being conductive to the best results.

"The process of light production is, according to my views, as follows: The street current is passed through a machine which is an electrical oscillator of peculiar construction and transforms the supply current, be it direct or alternating, into electrical oscillations of a very high frequency. These oscillations, coming to the metallically-coated ends of the glass tube, produce in the interior corresponding electrical oscillations, which set the molecules and atoms of the inclosed rarefied gases into violent commotion, causing them to vibrate at enormous rates and emit those radiations which we know as light. The gases are not rendered incandescent in the ordinary sense, for if it were so, they would be hot, like an incandescent filament. As a matter of fact, there is very little heat noticeable, which speaks well for the economy of the light, since all heat would be loss.

"This high economy results chiefly from three causes: First, from the high rate of the electrical oscillations; second, from the fact that the entire light-giving body, being a highly attenuated gas, is exposed and can throw out its radiations unimpeded, and, third, because of the smallness of the particles composing the light-giving body, in consequence of which they can be quickly thrown into a high rate of vibration, so that comparatively little energy is lost in the lower or heat vibrations. An important practical advantage is that the lamps need not be renewed like the ordinary ones, as there is nothing in them to consume. Some of these lamps I have had for years, and they are now in just as good a condition as they ever were. The illuminating power of each of these lamps is, measured by the photometric method, about fifty candle power, but I can make them of any power desired, up to that of several arc lights. It is a remarkable feature of the light that during the day it can scarcely be seen, whereas at night the whole room is brilliantly illuminated. When the eye becomes used to the light of these tubes, an ordinary incandescent lamp or gas burner produces a violent pain in the eye when it is turned on, showing in a striking manner to what a degree these concentrated sources of light which we now use are detrimental to the eye.

"I have found that in almost all its actions the light produces the same effects as sunlight, and this makes me hopeful that its introduction into dwellings will have the effect of improving, in a measure now impossible to estimate, the hygienic conditions. Since sunlight is a very powerful curative agent, and since this light makes it possible to have sunlight, so to speak, of any desired intensity, day and night in our homes, it stands to reason that the development of germs will be checked and many diseases, as consumption, for instance, successfully combated by continually exposing the patients to the rays of these lamps. I have ascertained unmistakably that the light produces a soothing action on the nerves, which I attribute to the effect which it has upon the retina of the eye. It also improves vision, just exactly as the sunlight, and it ozonizes slightly the atmosphere. These effects can be regulated at will. For instance, in hospitals, where such a light is of paramount importance, lamps may be designed which will produce just that quantity of ozone which the physician may desire for the purification of the atmosphere, or if necessary, the ozone production can be stopped altogether.

"The lamps are very cheap to manufacture, and by the fact that they need not be exchanged like ordinary lamps or burners they are rendered still less expensive. The chief consideration is, of course, in commercial introduction, the energy consumption. While I am not yet prepared to give exact figures, I can say that, given a certain quantity of electrical energy from the mains, I can produce more light than can be produced by the ordinary methods. In introducing this system of lighting my transformer, or oscillator, will be usually located at some convenient place in the basement, and from there the transformed currents will be led as usual through the building. The lamps can be run with one wire alone, as I have shown in my early demonstrations, and in some cases I can dispense entirely with the wires. I hope that ultimately we shall get to this ideal form of illumination, and that we shall have in our rooms lamps which will be set aglow no matter where they are placed, just as an object is heated by heat rays emanating from a stove. The lamps will then be handled like kerosene lamps, with this difference, however, that the energy will be conveyed through space. The ultimate perfection of apparatus for the production of electrical oscillations will probably bring us to this great realization, and then we shall finally have the light without heat or 'cold' light. I have no difficulty now to illuminate the room with such wireless lamps, but a number of improvements must be made yet before it can be generally introduced."

THE TWIN-SCREW CRUISING YACHT "PRINZESSIN VICTORIA-LUISE."

During the past week there was lying at the docks of the Hamburg-American line a vessel which was conspicuous for its clipper stem and flaring funnels, features which, while they were common enough in the trans-Atlantic steamers of twenty-five years ago, are not seen in these days, outside of the private pleasure yacht. Although this vessel flies the flag of a trans-Atlantic line, she is in design and appointments an out-and-out yacht, which differs from other yachts mainly in her great size. The "Prinzessin Victoria-Luise" was designed for a class of service which hitherto has been performed by the regular ships of this company, and she is, we believe, the first vessel of her kind to be built for a trans-Atlantic steamship company purely for yachting purposes. She is 450 feet in length, 47 feet in beam, 30 feet in depth, and of 4,500 tons displacement. She is driven by twin-screw, quadruple-expansion, engines of 4,000 horse power. These are capable of driving her at a speed of 16 knots an hour, but since speed is not one of the objects of a pleasure cruise, the vessel will ordinarily be driven at from 13 to 13½ knots an hour. The capacity of the ship is determined by the seating accommodation of the dining saloon, which is rated at 220. None but first-class passengers are carried, and the staterooms, which are unusually commodious, contain no upper berths; a large number of the rooms, moreover, contain but one berth. A novel feature, which, like many others peculiar to this vessel, was recommended by the Emperor William, is the provision of double-light portholes, which, by turning a crank, may be swung open when the vessel is in southern latitudes. Other special features are the provision of three-sided shelters facing to the stern, which will enable passengers to remain out on deck in stormy weather without being exposed to wind or spray; a large gymnasium and a darkroom.

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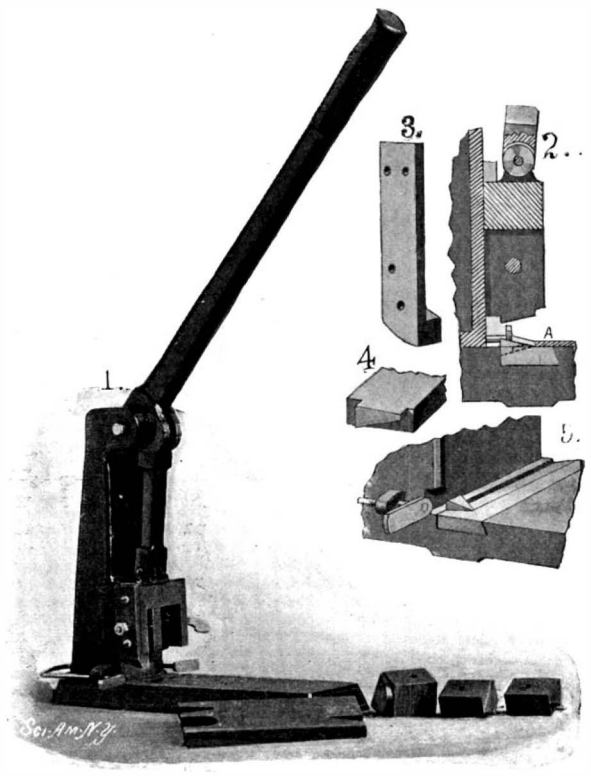
A SIMPLE SAW SETTING AND GUMMING MACHINE.

The invention which forms the subject of the engraving annexed is a novel machine for setting and gumming saws, which machine has been patented by Mr. John I. Newburg, of Vicksburg, Miss.

The machine comprises a base, an upright frame carried by the base, and a plunger operated by a lever pivoted in the frame. The base is formed with a transverse groove, which receives a removable member carrying a fixed setting-die of the shape shown in Fig. 5. At one side of the fixed setting-die, the removable member is provided with an inclined plane, which is used in setting the saw-teeth. In one of the recessed sides of the plunger is a detachable, angular die co-acting with the fixed setting-die. As shown in Fig. 3, the detachable die is provided with a square portion and an inclined portion, the latter conforming with the upper side of the fixed die. The plunger is yoke-shaped; and between its forks a setting-die is carried adjustable by means of a set-screw. On the base of the machine a gage is arranged, consisting of wings carried by a bail of wire, which is held in adjusted position by a set-screw.

To insure a uniform setting of the saw-teeth, the gage is properly adjusted so that the teeth will bear against the wings mentioned. By means of its set-screw the setting-die carried in the plunger-yoke is then brought over the tooth next to that resting on the fixed die. The plunger is now forced down by means of the lever, and the two teeth mentioned are simultaneously set. The angular die on the side of the plunger co-acts with the fixed die in the base of the machine to force one tooth up; and the setting-die carried in the plunger-yoke forces the adjacent tooth down into the incline before mentioned. By reason of the arrangement and novel form of the dies shown in Figs. 3 and 5, the teeth are flattened before they are set.

In order to use the machine as a gummer, the dies are all removed. In place of the setting-die carried in the plunger-yoke, one of three gumming-dies is employed, which gumming-die acts in conjunction with a correspondingly-formed notch in a plate placed on the base. The plate is formed with three notches, each adapted to receive a gumming-die. Of the three gumming-dies, one cuts the larger spaces of cross-cut saws; a second, the spaces of gang and band saws; and the third, the smaller spaces of cross-cut saws. Any of the dies can be placed in position in the plunger and used in conjunction with the corresponding notch in the plate to cut spaces of the proper kind. The machine is readily converted from a setter into a gummer. The construction is such that a straight saw of any size can be set or gummed without any mechanical skill whatever.



THE NEWBURG SAW SETTING AND GUMMING MACHINE.

FAMOUS BASALTIC COLUMNS.

BY PROF. CHARLES FREDERICK HOLDER.

Scattered over the world are some famous basaltic columns, and among the most interesting are those which have been discovered in the extreme southeastern portion of the Yosemite National Park; a region so out of the way and inaccessible that few have visited it. Mr. Lukens, ex-Mayor of Pasadena, has succeeded in photographing the columns, reproductions of which are given in the accompanying engravings. The deposit is known as the "Devil's Post Pile," and is well worth the time and trouble necessary to make the trip. It is located on the middle fork of the San Joaquin River, in strange contrast to a rich green meadow above it. Near by lava streams can be recognized, suggesting its origin. The columns crop out in various places; in some looking like a vast honey-comb; at others resembling a gigantic pipe-organ. The finest group is called the "Devil's Post Pile," and stands directly on the bank of the river, showing a mass of magnificent columns from sixty to seventy feet in height and from eighteen inches to three feet in diameter. Some of the columns are perfectly straight; others are twisted and bent, and at one point the entire mass has been so twisted and bent that it has the appearance of flowing water. Earthquakes have played havoc with the columns; broken them off, toppled them over, so that in front of the array of piles there is a talus of broken columns resembling a pile of Titanic bricks. Basaltic columns wherever found invariably arouse great interest, and their presence has given especial significance to many localities. The rock is of undoubted volcanic origin, and near the columns in the Yosemite can be seen the flow of ancient lava. The rock is made up of feldspar and augite or hornblende, and is usually dark green, gray, or black in color. The columnar form which it often takes has given rise to much discussion. The prisms are five or six-sided, and resemble crystals, and are so considered by many; this being denied by other authorities, while others again consider the strange prisms to be merely the result of a tendency toward crystallization. Be this as it may, the great mass in the Yosemite Valley resembles a wall of crystals growing out of the earth; yet they are undoubtedly a result in past ages of impeded contraction, the hexagonal shape being due to the fact or law that this is the only possible result of "the combined action of contracting forces acting in all directions in one plane."

Some of the most famous basaltic columns are to be seen in Nova Scotia, at Bergen Point, N. J., and in various portions of the Rocky Mountains and the Sierra Nevadas. The Giant's Causeway, in Ireland, is noted the world over; and the Palisades of the Hudson are examples of columnar structure. Perhaps one of the most interesting examples of these singular columns is found on the small island of Staffa, in the Hebrides group, which is undoubtedly of volcanic origin. This island appears to be built up of stone piles, and in olden times it was the belief of the people who lived on the adjacent islands that the columns were made by human hands. To the casual observer it would seem that the columns had been placed regularly in position and the earth piled on top of them. This island, in all probability, is the most famous basaltic formation in the world, and is permeated in every direction with caves; the water having eaten into the interior and broken away the columns. One of the best known is the "Cave of Music." The water flows in through an opening, giving rise to sounds which are supposed to be more or less harmonious. This cave lies on the southern side of the island, extending inward in a northeast direction for about two hundred and thirty feet. The entrance is impressive, being seventy feet in height and fifty feet in width, with an architrave thirty feet high surmounting it. On the sides are perfect and beautiful columns of greenish-black color, symmetrical and regular. They range from eighteen to thirty-six feet in height, and give the appearance of a huge organ, this idea being still further carried out by the rhythmical surge of the sea which sweeps into the cave, producing a loud and truly musical sound. It is rarely that the cave can be entered, as it faces the prevailing wind, and usually a heavy sea rolls in making it impossible for boats to live; but on rare occasions visitors have made the trip and have described many beauties of structure which are not discernible from the mouth. The ceiling is particularly beautiful, the columns being so worn away that they show the scar of the hexagon alone or its shape. Around the edges a white or yellow substance, looking like lime, has exuded, filling up the crevices so that in effect there is a colossal mosaic.

The Giant's Causeway has a rival in the basaltic formation discovered a few years ago in the Orange Mountains, of New Jersey. This formation has been traced about one thousand feet along the face of the mountains, and presents a commanding front of hexagonal columns perfect in detail and ranging in height from thirty to one hundred feet. The columns are remarkable for their size, some being four feet across a single side, while the smallest range from two to two and a half feet across the sides. These gigantic columns present a most impressive front, and the contrast between them and those of the Giant's Causeway can be realized when it is known that the columns in the latter are hardly twenty feet in height and from fifteen to twenty inches across.

The Orange Mountain columns occupy what was once an ancient volcano. The molten matter was forced out through the fractures or the inclined ledges of the rock to the surface, where it has cooled into the peculiar five or six-sided shape. In almost every instance these deposits are inaccessible or difficult to approach, but the authorities in the Yosemite, it is said, propose to make a trail to this new wonder of the National Park, so that it can be easily reached, and it will soon take its place among the great attractions of this region.

BASALT COLUMNS CALLED "DEVIL'S POST PILE"—YOSEMITE NATIONAL PARK

BASALT COLUMNS—YOSEMITE NATIONAL PARK.

In his annual report, Prof. Pickering, of Harvard College Observatory, again refers to the need of a large telescope in the Southern Hemisphere to carry on work which cannot be done in the North. It is of the highest importance to provide for special work on the extreme Southern stars, and a great telescope installed in some elevated station in the Southern Hemisphere, at Arequipa, Peru, for example, is necessary.

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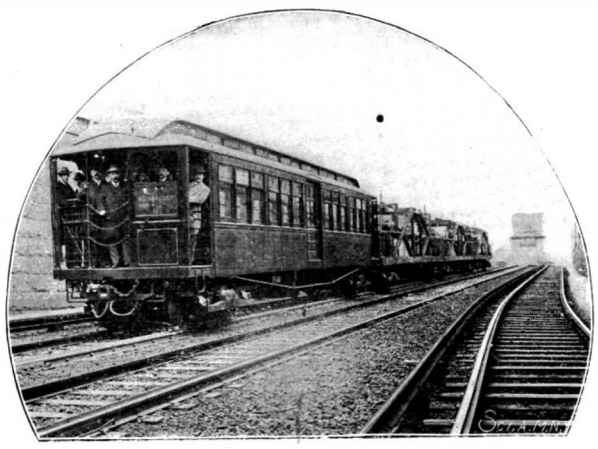
UNIQUE ELEVATED-UNDERGROUND STREET RAILWAY IN BOSTON.

BY J. A. STEWART.

Boston's new elevated railroad, soon to be set in operation, presents many features of interest, but none is so unique as its ingenious plan of connection between the new elevated system and that thoroughly approved construction—the subway. It is not every city that can run an elevated railway underground;



ACCEPTED TYPE OF CAR.

and this is what Boston is about to do. When the plans of the Elevated Railway Company, which, under the act of 1897, had been submitted to the Board of Railroad Commissioners, for approval, were examined by this commission, it was found that they rendered necessary extensive alterations at the Pleasant Street entrance to the subway, which would cut off all connection between the subway tracks and the surface tracks on Shawmut Avenue and Tremont Street.

The position taken by the company was that train service on the elevated road was practically a necessity; and that all surface cars from Shawmut Avenue and Tremont Street should consequently be excluded and the two outer tracks of the subway be devoted exclusively to the elevated service. The Boston Transit Commission, on the other hand, held that a new subway on Washington Street should be built to accommodate elevated train service. It was deemed inexpedient by them to adopt a plan of operation, or to make alterations in the subway which would prevent surface cars from entering it at the Pleasant Street terminal. It was proposed by the Transit Commission, with a view to providing for both the elevated and the surface cars, that the Elevated Company make connection within the subway with the tracks now devoted to the Shawmut Avenue traffic, which connection, it was claimed, could be made with but little expense and without material alterations of the company's plans for approach to the subway. Moreover, this would leave the connection with the two Tremont Street tracks unimpaired and ready for use at such time in the future as another and better route for the elevated road should be secured.

The plan of the Elevated Company, however, carried the day and won the unconditional approval of the Board of Railroad Commissioners. By its provisions the inbound elevated railway track is joined within the entrance to the subway with the present inbound Shawmut Avenue track, and the outbound elevated track is connected with the present outbound Tremont Street track, thereby doing away with all connection between the surface tracks and the subway.

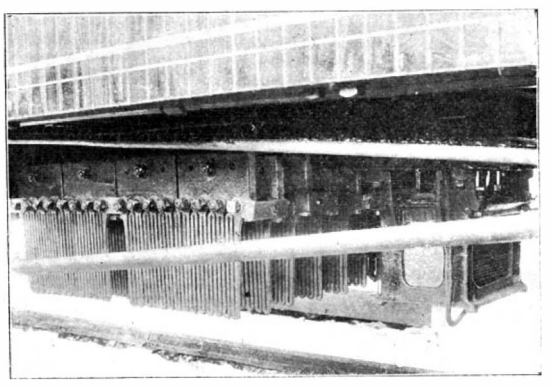
The Transit Commission has held that this plan involves a radical departure from the plan and purposes of the subway as originally designed. It is pointed out that the route for the subway selected by the Legislature was well adapted to a service of street cars running singly or in pairs, but that it was not so well adapted for a train service, for which a route with fewer curves and less severe grades would have been better. It is declared that the original charter of the Boston Elevated Railway Company, which formed part of the same legislative act which authorized the construction of the subway, did not contemplate the running of the cars of the company through the subway. The subway, it is claimed, was constructed to meet the requirements of surface lines only. As is well known, a large expenditure was incurred at the Pleasant Street terminal to admit the traffic of two tracks on Tremont Street, south of Pleasant Street, and of the two tracks on Shawmut Avenue to be consolidated on two tracks within the subway without grade crossings. This expensive construction, it appears, has now been rendered useless by the alterations required to meet the Elevated Railway's plans.

RELAYING PIPES ON SURFACE STREET OVER THE ELEVATED.

The work of making these changes has involved the taking out of the former incline which rose to the surface at Pleasant Street, the removal of two tracks, and the extension of the subway to a distance of about 40 feet under Pleasant Street, to avoid a grade crossing. This work has involved an expenditure by the city of about $300,000.

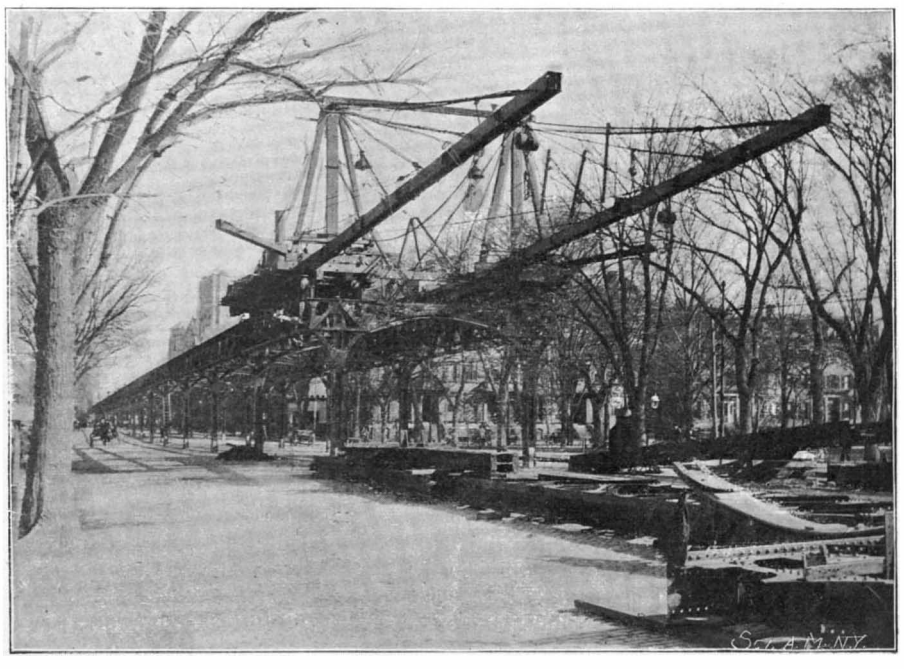
The Elevated Railway's route traverses Washington Street north from Dudley Street to Castle, turning west on Castle to Emerald Street, whence it describes a curve as it crosses the Boston and Providence and Boston and Albany Railroads. The tracks are supported on two substantial stone piers over the railroad crossing, and carried to a high retaining wall of masonry on the north side of Castle Street. A storage battery building, with 2,500 horse power to aid cars up the incline, is located at the head. The incline which leads directly into the subway is 540 feet long and 40 feet wide. It is built on private property, parallel with Porter Street, and is similar in construction to the subway. Its high masonry retaining walls are surmounted by a neat brick parapet. Its bed is of concrete on waterproofing, with the requisite drains. The gradient commences at 2.48 per cent; increases to 3.8 per cent at the curve, and after crossing Corning Street to 5 per cent.

ELEVATED COMPANY'S INCLINE, LOOKING NORTH TO SUBWAY ENTRANCE UNDER PLEASANT STREET.

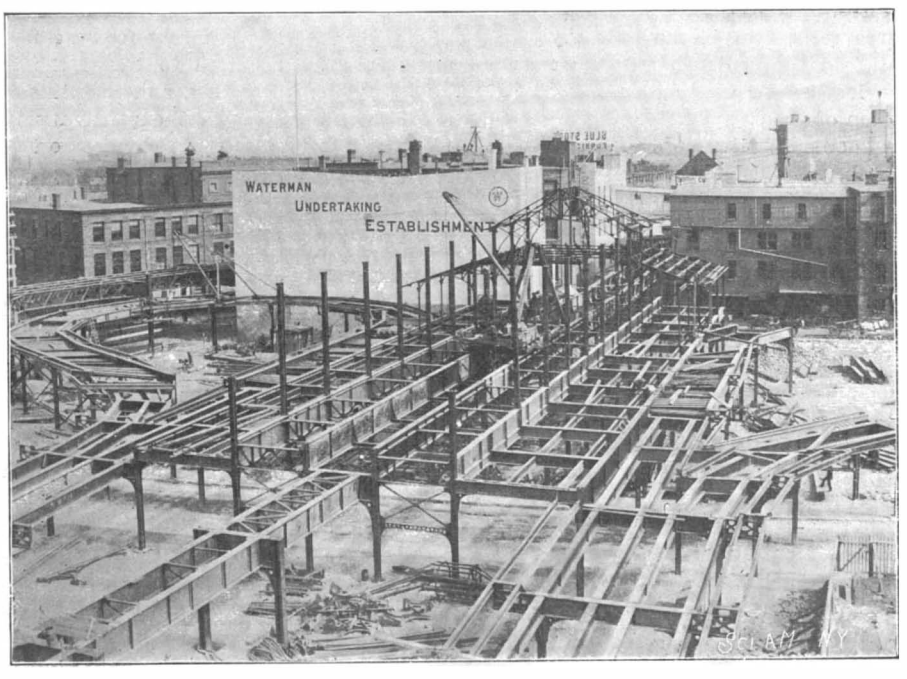


RESISTANCE COILS UNDER CARS.

By the changes necessary to make connection be-



TRAVELER USED IN ERECTION.



CONSTRUCTION OF DUDLEY STREET TERMINAL.

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tween the elevated and the subway, as has been stated, two tracks have been abolished in the subway between Hollis Street and Pleasant Street. The alteration also renders useless the sub-subway which was constructed at Boylston Street to avoid a grade crossing.

Moreover, the entire rearrangement of the surface of Pleasant Street has been rendered necessary. New sewer and water pipes have been built, as well as new surface tracks.

A unique transfer station will be located at the Pleasant Street terminal. Under the new order passengers on the surface line (which will run only to this point) will perform the paradoxical feat of descending to take the elevated.

At the Haymarket Street or north terminus of the subway, the convergence of underground and elevated has been comparatively a simple feat. In this case, the plans of Commission and company were coincident from the beginning, and no drastic change is involved. The elevated simply takes advantage of the slope already existing to run into the subway. Coming south over the new Charlestown Bridge en route from Sullivan Square the elevated train will turn west on Causeway Street, south again at Haverhill Street, to descend directly into the subway. There is no earthwork, but the steel superstructure will be maintained on pillars constantly decreasing in height at a practically continuous grade of 5 per cent. The north terminus will also have a transfer station to be composed of elevated station above and surface platform below.

The type of cars chosen by the Boston Elevated Company, as shown in our illustration, are fitted with the Sprague electric control and with Westinghouse motors. The elevated cars will move in trains of three to five cars, with complete motor equipment on each car; an arrangement that enables them to be run separately if required.

In order to facilitate rapidity, the plans approved by the Railroad Commissioners provide for only a very few stations. The surface cars will furnish accommodation for short distances. It is evident that unless elevated trains can run a considerable distance without a stop, there is no saving in time. As laid out, there will be a reduction of two-thirds of the schedule time.

Under the new regime of combination of subway and elevated, Boston's street railway patrons will travel faster within the heart of the city than they do upon its borders.

THE STEEPEST RAILWAYS IN THE UNITED STATES.

BY WALDON FAWCETT.

The New World enjoys the distinction of possessing the pioneer mountain-climbing road as well as the steepest. The line referred to is the railway which ascends Mount Washington, in the White Mountains, New Hampshire, the highest peak east of the Rockies in America. The Mount Washington road, the construction of which occupied the three years from 1866 to 1869, has the exceptional ascent of one foot in 2.67 feet. In point of steepness of grade the nearest approach in this country is the Pike's Peak Railway, another American mountain-climbing road, which has a grade of one foot in four. The Pilatus, the most nearly perpendicular of the European roads, has a grade of 48 in 100.

The trip to the summit of a mountain via a railroad equipped with modern safety devices is fraught with very little danger. Indeed, in the third of a century that the Mount Washington road has been in operation, not a single passenger has been injured. All the mountain-climbing railways in which American engineers take such pride are of the type known as the "cog road." The trains, each consisting of a locomotive, tender and one small passenger coach, run on three rails, two of the ordinary pattern and a "cog rail," in the center of which runs the cog wheel of the locomotive, thus propelling the train. The application of the cog principle to the propulsion of cars up an inclined railway was the invention of Sylvester Marsh, who had to undergo the vicissitudes that proverbially come to inventors. When, after months of work, he finally made a model of his proposed road and exhibited it to the New Hampshire Legislature, to which he had made application for a charter, one skeptical lawmaker sneeringly proposed giving him a charter for a road to the moon. It was eight years later that the first diminutive snorting engine reached the summit of Mount Washington, 6,291 feet above the level of the sea, and the achievement represented an expenditure of fully $150,000; but when the success of the innovation was assured, Swiss and German engineers hurried to America, and it was decided forthwith to adopt the principle in the construction of a road up Mont Riga.

The hump-back locomotives which drag the dumpy little passenger coaches up the great, rocky hillside are unquestionably the queerest appearing engines in the world. The first engine constructed, which, by the way, was one of the greatest curiosities at the World's Columbian Exposition, in Chicago, in 1893, had the upright type of boiler suspended on trunnions, as it was thought it must be kept vertical, but owing to the changes in grades, it would oscillate and form a dangerous opening in the footboard. Worse than all was the fact that there was no device for feeding water to the boiler, so that the only plan to pursue was for the train crew to fill it up before starting, go as far as they could with safety, and then let the steam down again and fill up the boiler from pails of water. Still, it was this certainly crude machine that demonstrated to the world the practicability of the mountain-climbing locomotive.

The engines now in use have the ordinary type of locomotive boiler, but are somewhat shorter owing to the steepness of the track. The boilers are set in the frames with the front ends a foot and a half lower than the back, so as to strike a medium between the flat and sharp grades. To eliminate all danger, all the locomotives have double driving shafts and gear. Not to burden the reader with a technical description, it may be explained that each of these iron horses has two pairs of cylinders, each pair being connected with a toughened steel crankshaft. The dozen teeth of the crankshaft bite against the sixty-four teeth on the main or driving axle. On this axle, too, is the main cog wheel, which meshes in the cog rail in the center of the track and sends the locomotive forward six feet at each revolution.

Like the wiry little burros which they have displaced, these bantam engines have wonderful power. Imagine a building 3,700 feet in height, if such a thing were possible, and a block of granite on the ground, weighing eighteen tons. If such a piece of stone could be lifted to that height in a little over an hour, the engineering world would stand aghast, and yet this is practically what each of these little locomotives does on every trip. At the steepest part of the Mount Washington road, the famed Jacob's Ladder, the track has a rise of nearly two thousand feet to the mile, and during a test on this part of the line a locomotive was found to transmit to the cog wheels more than five hundred horse power.

In coming down the mountain no steam whatever is used, gravity alone doing the work and the machinery holding back. The time consumed in making the trip from the base of the mountain to the summit is about one hour and fifteen minutes. At the beginning of the trip the passengers are all seated at open windows reveling in the bracing mountain air, but before the ascent is half completed the windows are all closed, for the atmosphere is decidedly sharp, even though the cities below are sweltering in heat. The mountain trains move very slowly, so slowly, in fact, that any person could easily step on or off the car while it is under full headway.

While not so steep, the Pike's Peak Railway, in Colorado, is of considerably greater length than its counterpart in the eastern part of the country, and carries passengers to an elevation of fourteen thousand feet, where in midsummer they are often caught in a fierce snowstorm driven by a fifty-mile-an-hour wind. The line up this most remarkable peak of the Rocky Mountains was first projected about sixteen years ago, but was abandoned. Actual grading commenced in 1889, and the golden spike was driven in 1890. The average grade is about sixteen per cent, although in places it is as steep as twenty-five per cent.

As in the case of the Mount Washington road, already described, there is fastened to the cross ties, between the rails, a unique type of rail, into the notches of which roll the teeth of a huge steel cog wheel, drawing the train forward, literally inch by inch, until the entire nine miles of the ascent is covered. The roadbed is from fifteen to twenty-five feet wide, and has been cut from solid granite. Nearly two hours is required to travel the length of the road in either direction, and that this form of mountain climbing is somewhat expensive may be appreciated when it is stated that the members of a farmers' convention which recently chartered the four trains or, in other words, six passenger coaches for a trip up Pike's Peak, paid $2,700 for the privilege.

Even the traveler making the ascent on this road would scarcely appreciate the amount of study devoted to the difficult problem of its construction by the best engineers and mechanics or the perils and hardships which attended the survey and the actual work of laying the metal highway. Camping out, climbing over mountains covered with fallen timber and jagged rocks, the occasional intense cold, terrible snowstorms often attended with high wind and the difficulty of getting provisions, made the obstacles to this undertaking almost insurmountable. A feature of the Pike's Peak line is that there is no trestle work whatever, the four short bridges being of iron, resting on solid masonry. To prevent the moving or sliding of the track—a contingency which is, of course, the remotest of possibilities—owing to its enormous weight and the effect of varying temperature upon iron and steel, nearly one hundred and fifty anchors are embedded into the solid rock or masonry at varying distances along the route.

The rack or cog rails are each less than seven feet in length and very heavy. The teeth were cut from the solid piece by machines especially constructed for the purpose. So particular were the constructors, that the contract for making these rails required that each tooth be within the fiftieth part of an inch of the specified size. On the Pike's Peak road there are two cog rails set a couple of inches apart. As in the case of the other American mountain-climbing railway, the locomotive pushes the car in ascending and precedes it when descending.

On the summit of each of the mountains reached by rail the United States government maintains an observatory and signal staion. The observatory on Pike's Peak is the highest in the country. The first building, erected in 1876 and which afforded the first signal officers shelter, is quite small and was abandoned in 1882 for the more commodious stone house built in that year under the direction of Chief Signal Officer Gen. William B. Hazen. At the summit of Mount Washington there is also a hotel, heated by steam, and capable of accommodating two hundred persons. It is frequently crowded to its capacity by the people who remain on the summit over night to witness the sunset and sunrise. On the summit of Mount Washington also is the office of Among the Clouds, the only newspaper printed on the summit of any mountain in the world. For more than a quarter of a century this novel publication has appeared regularly. Two editions are printed daily during the summer months in as complete a little printing establishment as a person could expect to find anywhere. The copies of the paper, which are to be mailed to all parts of the country, are taken down the mountain on "mail trains," sled-like vehicles which coast down the steep stretches of the mountain railway at terrific speed.

Automobile News.

Alfred C. Harmsworth, the London publisher, owns no less than eleven horseless carriages, eight being driven by gasoline motors, two by steam and one by electricity. He also employs a number of steam trucks for transporting magazines and newspapers from his various publishing houses.

The Automobile Club of America has taken up the subject of placing substantial signposts upon the leading highways. Automobilists, as well as others using the country roads, have complained for a long time about the lack of adequate signboard information. In many cases the old signs are allowed to decay or the information becomes illegible. The State and county authorities do not seem inclined to give attention to the matter. It was unanimously decided by the delegates of various automobile clubs to erect signposts of a uniform character, pointing out clearly the best roads between the principal points. The signs are to be like those used in France, made of iron, and practically indestructible. The route from New York to Boston will first be provided with these signs. Other routes, such as those from New York to Albany and possibly from Albany to Buffalo, and those on Long Island, will probably be attended to first. It is hoped in a short time, with the aid of these posts, it will be possible to travel with ease from Niagara Falls to Boston.

One of the heaviest automobile vehicles which has yet been constructed in France is the great hauling wagon built for the Say sugar refinery, to be used between the works and the railroad stations. It is an electric vehicle, and has been built at the Postal-Vinay works at Paris; it made its debut last year at the automobile fête at Vincennes, and since then has made good service in hauling heavy loads. The average load of merchandise is 11 tons, and as the vehicle and accumulators weigh as much as 13 tons, a total of 24 tons is reached. The electric motor, of special design, develops 20 horse power at normal running, but for heavy pulls may reach as high as 40 or 50; its speed is considerably slower than for the ordinary electric automobile. The vehicle travels at an average speed of 3 to 4 miles an hour on level road, this being considerably greater than the mean speed made by horses in like case. Even on grades it has proved very efficient and powerful; in one case a test was made on the well-known grade of Corbeaux, reaching 10 per cent, and it climbed up without difficulty at a speed of 2 miles an hour. During the month the registering instruments showed a consumption of 200 amperes at 155 volts, making 31,000 watts, or 40 horse power. The Say refinery is quite satisfied with the new system, and estimates that the vehicle gives an economy of $4,000 a year over horse vehicles; this figure includes the maintenance of the accumulators.

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Science Notes.

Johann Faber, the founder of the famous lead pencil factory, died January 15, at Nuremberg, at the age of eighty-four years.

At Hohkönigsberg, in Alsace, the remains of an early mediæval castle are to be restored by the German Emperor in the same way in which Pierrefonds was restored by Viollet le-Duc.

Large numbers of gold and silver medals have been awarded at the Paris Exposition, but the expense has evidently frightened the government to such an extent that only bronze medals will be given. Gold and silver medalists can have their medals struck in precious metals, provided they will pay for the same.

A bill is before the Kansas legislature asking for an appropriation of $10,000 with which to purchase poison to exterminate prairie dogs in Western Kansas. They are destroying thousands of acres in the western part of the State. Prairie dog wardens are to be appointed for each township to scatter the poison in the prairie dog towns.

The stereoscopic fluoroscope, a description of which was published in The SCIENTIFIC AMERICAN some time ago, has undergone one or two improvements. The most important is in the motor mercury break, which can be used with any coil. This break will work any current from 12 to 100 volts, and by its utilization the brilliancy of the image on the screen is considerably increased, and the flickering entirely obviated, which is a valuable desideratum. By the use of the Mackenzie Davidson break, the time of exposure is also considerably lessened if high voltages are utilized.

The plan of furnishing farmers who live in the State of New York with desirable reading matter is being carried out by the College of Agriculture of Cornell University under the provisions of the Nixon Bill. The plan is to furnish each farmer with a series of lessons bearing upon certain fundamentals of agriculture, for instance, the formation and cultivation of the soil, how the plant grows, and the nutrition of the animal. The lessons deal with principles; they incite thought and study. They are accompanied by questions which the reader is expected to answer and return to the College. These lessons form excellent material for discussion at grange, institute and club meetings. Applications may be addressed to the College of Agriculture at Cornell University, Ithaca, N. Y.

The Royal Botanical Society of Great Britain proposes to establish a large botanical institute at their gardens at Regent's Park, London. The work will be commenced in April next. At present the buildings of this society in the metropolis comprise a museum, lecture theater, a small library and herbarium. Probably the new building will resemble somewhat the institutions of the society already in existence at Dublin, Edinburgh, Oxford and Cambridge. Its necessity has been felt for some time past, especially by intending emigrants, who at present go to Germany to acquire their instruction, but would stay in London were there a proper establishment. Endeavors are to be made to affiliate the new institute with the London University, so that it may become one of the teaching schools incorporated with that body.

While excavating for a cellar in Marietta, O., a few hundred feet from the famous Mound Cemetery, the workmen dug into a mound builder's grave, which was supposed to be 2,000 years old. The grave was covered with three layers of heavy stones with 3 inches of fine white sand between each layer. When the third stone was raised, the bones of a large man were discovered. In the bones of each hand were solid copper axes. The bones crumbled on exposure for an hour. Large bits of charcoal were also found in the grave, as were the bones of wild animals supposed to have been deer. The grave was walled in on all sides, and also the top and bottom, with heavy stones. The body of the mound builder sat in an upright position, with the hands in a position as if supporting the body. The grave was 2½ feet wide by 2½ feet long and 5 feet deep, and the stones surrounding it were easily broken with the fingers, as they were very soft.

The pearl fishery off the coast of Tuticorin, which commenced on March 12 last and continued until the 28th of the same month (work having to be suspended, owing to the unwillingness of the divers to continue the fishing), has resulted in a dismal failure. This result is partially due to the immaturity of the oysters and the low prices realized in their sales. It was estimated that the net profit resulting from the fishing would aggregate about $43,600, instead of which only about $670 were realized. The government incurred no loss, but the work proved disastrous to the fishermen. The merchants combined, and thus succeeded in keeping down prices, and when it was discovered that the oysters were immature, and pearls were consequently scarce, a panic set in, and the cessation of work followed. If the fishery had been postponed a year, more profitable results might have ensued, but the oysters were only four years old and too young to be fished.

Engineering Notes.

The monumental gateway of the Paris Exposition with its surmounting statue has been sold for $2,000 to a dealer in scrap iron.

A large Milwaukee concern recently made a casting weighing 110,000 pounds, to serve as a bedplate for a blowing engine for the Carnegie Steel Company, Pittsburg, Pa. About 125,000 pounds of metal were poured in the process of founding.

The Chicago and Northwestern Railway, in order to enter Peoria, Ill., from Sterling has purchased the entire village of Pottstown, and will move all the houses in order to occupy the site of the town with tracks.

Moscow is probably the worst paved city in the world. Great cobblestones driven by hand into a loose bed of sand form a roadway which is always dusty in summer and muddy in autumn, and in many of the roads there is no attempt at a roadway of any kind. The streets are badly watered and cleaned. The yearly expenditure for these two operations is only about $155,000.

The Manufacturers' Association of New York recently appropriated the sum of $2,000 for an industrial scholarship, including the cost of tuition for four years and incidental expenses. The purpose of the association in providing means for the industrial education of a young man of Greater New York is to encourage young men to qualify themselves for leadership in industrial pursuits by adding to the dignity of labor the advantage of trained hands directed by developed minds. A commission has been appointed to arrange the details and to conduct the examination of the candidates.

In 1900 the Baldwin Locomotive Works built 1,217 engines, of which 363 were exported to foreign countries; 426 were of the Vauclain compound system; 48 were electric, and 6 were compressed air locomotives. The total weight of the product alone was 192,777,900 pounds, says The Railway Review, involving the consumption of 52,000 pounds each of forgings and castings, and the consumption of 90,000 tons of coal. Assuming that the average length over all of each locomotive and tender is approximately 60 feet, the year's product would form a continuous train nearly 40 miles in length. The average weight of the locomotive and tender for 1900 empty was 158,500 pounds, the average weight of the locomotives and tender empty for 1890 was approximately 106,000 pounds.

India affords a splendid ground for the sale of calcium carbide, inasmuch as there are no native producers of the article, and acetylene gas is in great favor, while its developments are limitless. At the present time the calcium carbide is being sold retail at less than twelve cents per pound. Considering that the English company, which has a large export trade with India, cannot retail the article at less than 25 cents per pound, it is evident that the country is being exploited by some producers, who are desirous of encouraging the employment of acetylene gas by flooding the market with immense quantities of carbide. By this means it would be possible to transport the article from a European country and to sell it at a very low price, the producers recouping themselves upon the large quantities disposed of.

For some time past complaints have been made regarding the inadequacy of the dock accommodation of the port of London. Steamers arriving in the Thames often have to wait days before they can approach the docks to have their cargoes discharged. Attempts are being made to improve the insufficiency of berthing space, etc., but the alterations are not being carried out with a speed commensurate with the rapid development of the traffic of the port. The Thames Conservancy, which is responsible for the administration and welfare of the river, are engaged upon the construction of a channel from the Nore to Gravesend 1,000 feet in width by 26 feet in depth; from Gravesend to Grayfordness, 1,000 feet wide by 24 feet deep; from Grayfordness to the Royal Albert Dock, 500 feet wide by 22 feet deep, and from the Royal Albert Dock to Millwall Docks, 500 feet wide by 18 feet deep. The work is completed as far as Gravesend, and rapid progress is being made with the rest of the work. It is intended to bring the River Thames up to the same standard of efficiency as the Mersey and the Tyne. At present, there are only eight vessels that cannot come up the river at all tides. The reason that the improvements have not been carried out before is due to the want of funds. To defray the cost of the present extensions it is estimated that an additional income of $750,000 per annum will be necessary. Extensions are also being carried out at the Surrey Commercial Docks on the south side of the river; $3,000,000 has already been expended, and another $1,250,000 will be necessary to complete the work. The new dock will cover an area of 21 acres, with an entrance lock from the river 550 feet in length by 80 feet wide, and a depth on the sill of 33 feet.

Electrical Notes.

Prof. Fleming, of London University, is now conducting important experiments in connection with the transmission of electrical energy. It is said that the professor has discovered means by which power can be distributed without wires by utilizing ether.

Shower baths are being put in the Paris telephone exchanges for the use of the telephone girls. It is thought that this will aid them in keeping their health. In America the girls in many telephone exchanges have long enjoyed this comfort.

A gutta percha substitute has recently been patented. It consists of a mixture of pulverized peat and resin oil. The peat is dried thoroughly and is then pulverized and sifted until it is about the fineness of flour. It is then mixed with equal parts by weight of resin oil and two per cent of amyl acetate. It is then stirred and worked until it forms a smooth dough-like mixture. It can be worked into shape, and is semi-hard like gutta percha.

In 1881 the Savoy Theater was lighted with electricity, and was probably the first public building to be so lighted. The public seemed to feel that there was great danger in the new illuminant. Mr. D'Oyley Carte showed that the pilot light of the gas chandelier was always kept burning, so that the auditorium could be flooded with gaslight at a moment's notice. He then smashed an electric lamp bulb to show that there was no danger from this source. The audience was invited, after the performance, to go behind the scenes to see the electric lighting on the stage.

The new plant of the Natural Food Company will be located at Niagara Falls. It will control the business of the Shredded Wheat Company, Worcester, Mass. The building will have many unique features. It will be five or six stories high, and will be built entirely of enameled brick, steel and glass. There will be a roof garden on the roof. The plant will be run by electric power furnished by the Niagara Falls Power Company. Niagara Falls is a center of railway communication, and the cheap power and the number of visitors which are sure to come each year will doubtless make the move of the company very successful.

Two inventors of London have devised an instrument, upon the penny in the slot principle, to be employed in connection with telephones. The apparatus consists of a small box, fitted with the ordinary receiving hook. This hook is locked in position, until the insertion of a coin, when it is automatically released by the action of the coin falling within the box. For the benefit of commercial houses, where the insertion of coins, whenever a call is desired, might occasion inconvenience, the inventors have devised an alternative arrangement. Instead of placing a coin in the machine to release the receiver, it is only necessary to detach the receiver from the hook in the ordinary way, but in so doing a small ratchet wheel within the box revolves one notch, the notch being equivalent to the coin's value. Should the person who rings up be unable to establish communication, the operator at the exchange can, by pressing a button, which, by means of an electric current, causes the ratchet wheel in the box to return one notch. The English Government are inaugurating their State telephone system upon the Toll system, and probably this contrivance will be given a trial, since it will obviate the necessity of recording every call at the exchange.

The Gustav Constanz Electric Company of Hamburg have recently erected a plant consisting of a windmill, a dynamo, a battery of accumulators and electric motors at Wittkiel, near Kappelin, for the electrical utilization of wind power to generate the electric light for the town of Wittkield. The wind motor, which has been designed by Mr. C. P. Neumann, of Wittkield, is 39 feet in diameter, has a wind area of 1,000 square feet, and develops more than 30 horse power. Its average speed is 11 revolutions per minute, which is governed by an automatic adjustment of the vanes. The dynamo is shunt wound, and when the wind velocity is 8 feet per second, makes 700 revolutions per minute, generating an electromotive force at 160 volts of 120 amperes. The positive field terminal is permanently joined to the battery pole, while the negative field terminal is attached to the switch of the regulating cells in the charging circuit. It is stated that the dynamo requires no manual regulation, nor is there any attachment supplied for automatically disconnecting the dynamo, since the motor apparently maintains its speed satisfactorily. An automatic switch is provided, however, in the discharge circuit in order to maintain the voltage at 110 volts. Large electric motors are directly connected with the dynamo with starters and speed regulators inserted in the connections. This plant was experimentally installed, simply to ascertain whether the wind power could be employed for electrical generation, and the trial proved so eminently successful that the erection of a larger plant, consisting of several wind motors and dynamos, is contemplated.

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DEATH OF PROF. ELISHA GRAY.

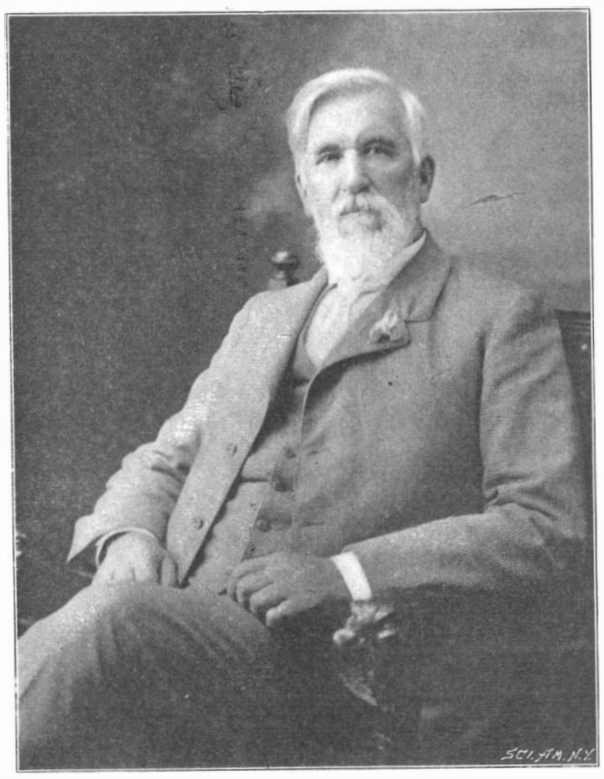
Elsewhere in this issue we illustrate and describe the last invention in which one of the electrical pioneers was engaged. The career of Prof. Elisha Gray, D.Sc., was a most pathetic one. He was a man of marvelous talent and ingenuity, and in the opinion of many who have calmly weighed all the evidence, it is likely that he will receive justice at the hands of future historians by being immortalized as the inventor of the speaking telephone. The litigation in the early history of the telephone, which was of the most complex nature, finally resulted in the decision that Prof. Bell was the inventor of the telephone, and as such was entitled to the credit and profits which would naturally accrue from such an important invention, but many persons hold that the victory was a technical and corporate one, rather than one based on science.

Prof. Gray was born at Barnesville, O., in 1835, and commenced his career as a blacksmith, and also served an apprenticeship to a carpenter and boatbuilder. At Oberlin College he constructed the apparatus used in the classroom for experiments, and acquired the knowledge of that time in regard to electricity and its applications. He spent five years at college; and six years later obtained his first patent, this was the percursor of some fifty others. His first patent was granted on an automatic self-adjusting telegraphic relay. In the early seventies he devoted great attention to the phenomena of sounds transmitted over telegraph wires—electro-harmonic telegraphy. In pursuing his investigations he made a discovery to which the invention of the telephone was largely due. He relates it in his own words:

"My nephew was playing with a small induction coil, taking shocks, for the amusement of the younger children. He had connected one end of the secondary coil to the zinc lining of the bathtub, which was dry. Holding the other end of the coil in his left hand, he touched the lining of the tub with the right. In making contact, his hand would glide along the side for a short distance. At these times I noticed that a sound was proceeding from under his hand at the point of contact, having the same pitch and quality as the vibrating electrome."

On February 14, 1876, Prof. Gray filed a caveat in the Patent Office at Washington with the expectation of perfecting the "art of transmitting vocal sounds telegraphically." Prof. Alexander Graham Bell and Prof. Dolbear were workers in the same line, and it is said that Prof. Bell's patent was applied for a few hours earlier than Gray's, therefore the former received the patent. In the litigation which ensued, Gray alleged that his caveat had been on file before Bell's application, and he contended that there had been collusion with an official of the Patent Office. The courts decided, however, that this was not the case, and ruled against the Chicago inventor. Prof. Gray parted with his rights to a company whose name was The Harmonic Telegraph Company, by which transaction the Western Union was retired from the field.

Another of Prof. Gray's inventions was the telautograph, which was so far an improvement on the telephone and telegraph as it transmitted the actual writing of the message. He also invented various telegraph and telephone instruments and appliances, and the last work on which he was engaged was the perfection of a system of under-water fog signals, which is fully described in the present issue. As an inventor he sought to avoid multiplicity of mechanical devices. Intricacy to his mind was a failure. He sought to make electricity do its work directly, and all his devices were to this end.



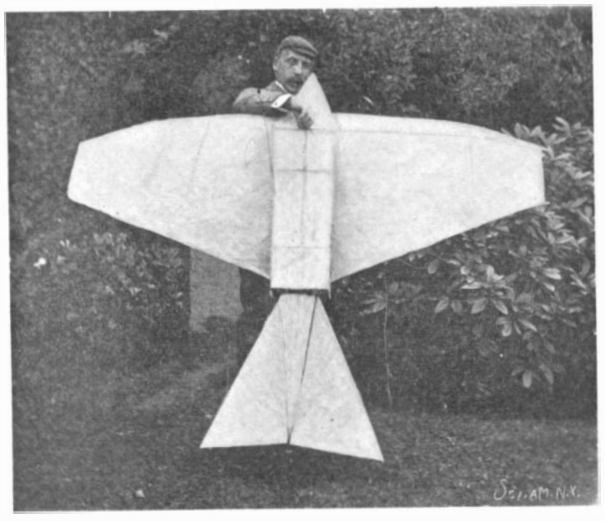
THE LATE PROF. ELISHA GRAY.

A NEW FLYING MACHINE.

An ingenious flying machine has recently been designed by a Scotchman, Mr. G. L. O. Davidson, of Inchmarlo, Scotland.

Mr. Davidson has based his machine upon the principle of the flight of the bird. In flying, a bird does not propel itself through the air, but glides forward by opposing the resistance of its wing surface to the air. It will be recollected that both Lilienthal and Pilcher adopted this theory in their respective machines, and were eminently successful in gliding downward through the air from an eminence, and although they ultimately met their deaths during the course of their experiments, their untimely ends were not due to faulty theories, but through mishaps to their apparatus. In flying, a bird flaps its wings up and down, which has the effect of raising it in a vertical direction, and then between the beats it glides forward, and the constant repetition of this action produces forward flight. In the smaller quick-flying birds these movements are scarcely discernible, owing to the rapidity with which the wings are flapped, but with the heavier and larger birds, such as the albatross and gull, the movements are perfectly distinguishable.

The result of these investigations convinced Mr. Davidson that the successful flying machine must be heavier than the air, and that it must not be raised by means of the balloon, but by a mechanical agency in which the vertical raising power should be greater than the downward pull of gravity. To propel a machine upward against gravity, only a small fraction of the operator's power is available to overcome the attraction of gravity, and the weight of the apparatus to generate sufficient power for this purpose is always more than it can lift. In his machine the lifting power is greater than gravity, so that the apparatus can easily lift itself, the combination of the two forces supplying the necessary forward motion to the machine.



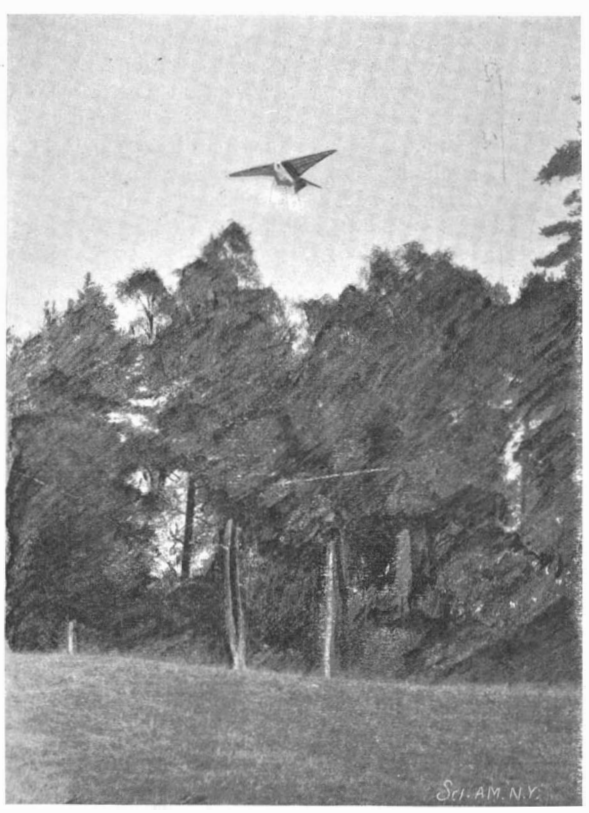
PLAN VIEW OF FLYING MACHINE.

In design, the Davidson machine resembles a huge bird with its wings fully extended. The body of the bird constitutes the car, in which are placed the steam turbines for generating the necessary power to actuate the lifting appliances, placed at the extremities of each wing. These "lifters," as they are called, resemble rosettes of flanges, placed horizontally, and in revolving obtain a purchase on the air in the same manner as the propellers of a steamship beat the water. Directly these lifters are actuated to a velocity which yields an upward vertical thrust greater than the downward gravity pull, the appliance rises, and as the body of the machine is inclined at a slight angle it is constantly sliding forward through the air, rising in a diagonal direction until the desired altitude has been attained. If the speed of the lifters is decreased, so that the downward gravity attraction exceeds the upward vertical pull, the vessel then glides at a downward angle, the angle being controlled by the movements of the lifters, but at the same time the automatic equilibrium gear can be set to maintain any desired angle. If the lifters, while traveling at the maximum speed, are suddenly arrested, the machine does not stop, but continues its flight, gliding gradually to the ground meanwhile. The velocity of the lifters depends, of course, upon the dimensions of the machine, since the length of the blades is proportionate to the size of the vessel. In a machine weighing ten tons, which would be the smallest practicable vessel, the blades would each measure twenty feet in length.

Another ingenious or striking characteristic of the vessel is the method by which its equlibrium is maintained. To the rear of the car is attached a huge tail, similar to that of a bird arranged in three movable sections. This mechanism is automatic in its action, but can be governed at will. Should the car list to either side, the tail immediately assumes the necessary position to restore it to its normal vertical poise. By this means, it is impossible for the machine to capsize. To substantiate this important feature, in the course of his experiments with the model (illustrations of which are shown) the inventor released it upside down from a great height. Before the craft had fallen many feet, it had reverted to its correct position, and then glided slowly to the ground. The equilibrium of the vessel therefore cannot be deranged, even if the wind is blowing upon it broadside. The machine is steered from the fore part, which acts as a beak, the gear being controlled by hand.

Mr. Davidson proposes to come to the United States to construct a full sized experimental machine weighing ten tons, with which to demonstrate its capabilities. Such a vessel will be 60 feet in length, by 120 feet in width, and will provide accommodation for fifty passengers. It may be supposed that such an immense craft will prove weighty and unwieldy, but such will not be the case, since although the framework will be built of soft steel, the specific gravity of the vessel will be no more in proportion to its outspread surface than that of a bird. The vessel will be equipped with engines capable of exerting a lifting force of three feet per second.

MR. DAVIDSON'S FLYING MACHINE.



MR. DAVIDSON'S FLYING MACHINE IN FULL FLIGHT.

Some experiments in wireless telephony have been carried out at Minneapolis, Minn., and messages were successfully transmitted a distance of a thousand feet across the Mississippi. The conditions were not favorable, owing to the nearness of two electric railways. The weather conditions were also bad, but words spoken were distinctly understood.

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THE NEW YORK CYCLE AND AUTOMOBILE SHOW

SOME NOTABLE EXHIBITS.

Among the many exhibits at the recent Madison Square Garden show were to be seen the two machines illustrated on this page, each of which will doubtless prove of interest to our readers.

One of these is the "Trimoto," of the American Bicycle Company—a little machine built somewhat on tricycle lines, yet having a wide enough seat to carry two persons comfortably. A general idea of this machine can be formed from our illustration. The 2¼ horse power air-cooled motor, together with the tank, carbureter, etc., are all hung on the front or motor wheel, where they can easily be reached. The machine is steered by the horizontal steering lever, and the speed is governed by turning the handle of the same. The motor is started with a crank, the steering lever being first raised about forty-five degrees. When the handle is lowered, the motor is thrown into gear with the front wheel by compressing a band brake. There is no low-speed gear or reverse. The motor is fitted with roller bearings and equipped with a much larger flywheel than is generally used with motors of this type. The flywheel and gears are on one side of the front wheel, the motor being on the other, and the wheel is so well balanced that it will stay in place if the hands are removed from the steering lever. The carbureter employed is constructed on the atomizer principle, and hot air is conducted to it through a pipe which ends in a flange that partly surrounds the cylinder. Electric ignition has replaced the hot tube igniter with which the machine was originally equipped. The gasoline tank has a capacity of 1½ gallons. The lubricating oil is kept in a small tank adjoining the gasoline tank.

The "Trimoto" weighs 400 pounds, and can make 12 miles an hour over average city or country roads.

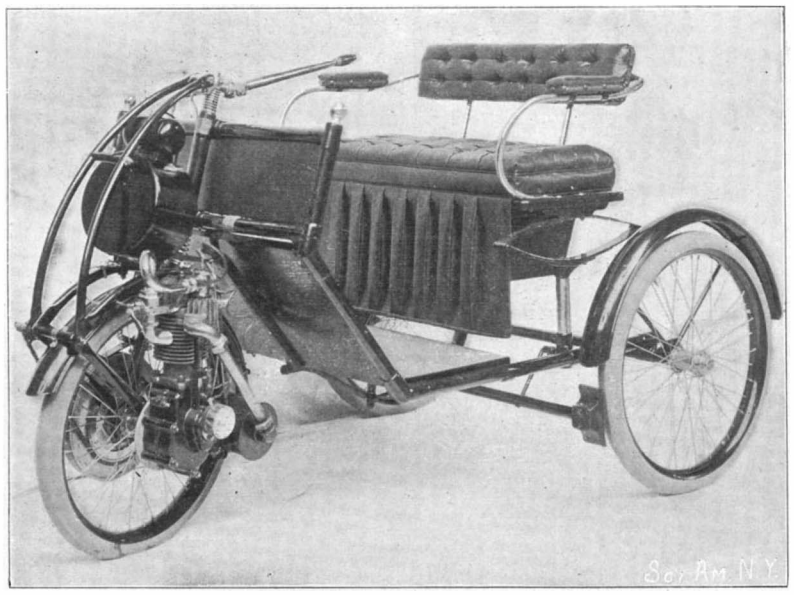
Now that the bicycle has reached its probable final design in the chainless bevel gear machine of 1901, it is interesting to note any further attempts at improvements, even though they prove abortive. Many of this year's bicycles are equipped with cushion seat posts; and spring suspension saddles, somewhat on the lines of the Kirkpatrick used on the early Columbias, were also to be seen at the recent cycle show.

These attempts at reducing unpleasant vibrations on the standard models are worked out in a different way by the inventor of the "freak" wheel here pictured, which was the only machine of its class on exhibition. The inventor, who hails from Jericho, N. Y., claims much less vibration to the arms through the lever extensions of the handle bar. Their main purpose, however, is to afford a means of propelling with the hands as well as the feet in ascending hills, the upward pull usually exerted on the handle bar being here applied directly in helping to rotate the pedals. The machine is steered by the thumbs, which operate the two small loops on the handles of the levers. These loops are connected to the steering head through a short handle bar, and move the front fork without moving the cross bar to which the levers are attached.

In operating this machine the rider exercises his arms as well as his feet; he is obliged to sit erect, and to bring all the muscles of the body into play as the latter sways slightly from side to side. So completely are all the muscles developed that not only do the toes pedal, but even the thumbs are trained to steer! For an all round out-of-door exerciser this Yankee invention certainly cannot be surpassed!

As for the pull by the arms in climbing a hill, although applied direct in a rotative effort, it is applied under the disadvantage of having the arms bent at the elbow at a constantly changing angle, instead of being straight, as in ordinary hill climbing. It is doubtful if this arrangement, although good exercise for the muscles of the arm, will develop the maximum power.

A FOOT AND HAND PROPELLED BICYCLE.



A GASOLINE "TRIMOTO" VEHICLE.

SUBMARINE SIGNALING.

BY ARTHUR J. MUNDY.

When the idea of a submerged signal first occurred to the writer he foresaw that he would be unable to develop it properly without the assistance of some master mind accustomed to wrestle with nature for her secrets. He therefore invited his friend, the late Prof. Elisha Gray, of telephone fame, to join him in the undertaking, and received in reply an enthusiastic acceptance. Prof. Gray brought to the subject a wide knowledge of the laws of acoustics in their relation to electrical science, which has enabled him to overcome difficulties that have heretofore seemed insuperable.

An experimental boat christened the "Sea Bell" was built and equipped with an 800-pound bell to be operated electrically, the necessary power being supplied by a small dynamo driven by a gasoline engine. This bell is lowered into the sea through a well-hole directly in the center of the boat until it is twenty feet below the surface. By an ingenious mechanism it may be either tolled continuously or made to ring any desired number or numbers, at the will of the operator, who is thereby enabled to send intelligible messages, each letter of the alphabet being represented by a given number.

The sound thus produced under water may be heard from a passing ship at a distance of, say, a mile or more, provided the observer go below in the hold of the vessel as close to the keel as possible and listen, just as he would listen for an air signal on deck. The sound waves produced by the bell come through the water and penetrate the skin of the ship, diffusing themselves in the atmosphere of the hold, where they are recognized by the unaided ear, just as any local sound might be. The sound is heard more plainly, however, by placing one end of a wooden rod against the skin of the ship, and pressing the other end against the outer ear.

A common tin ear-trumpet, such as is used by a deaf person, screwed into the end of a piece of gas pipe and submerged a few feet, the mouth of the trumpet being sealed with a tin diaphragm, will enable the observer at the upper end of the pipe to hear the bell a distance of three miles.

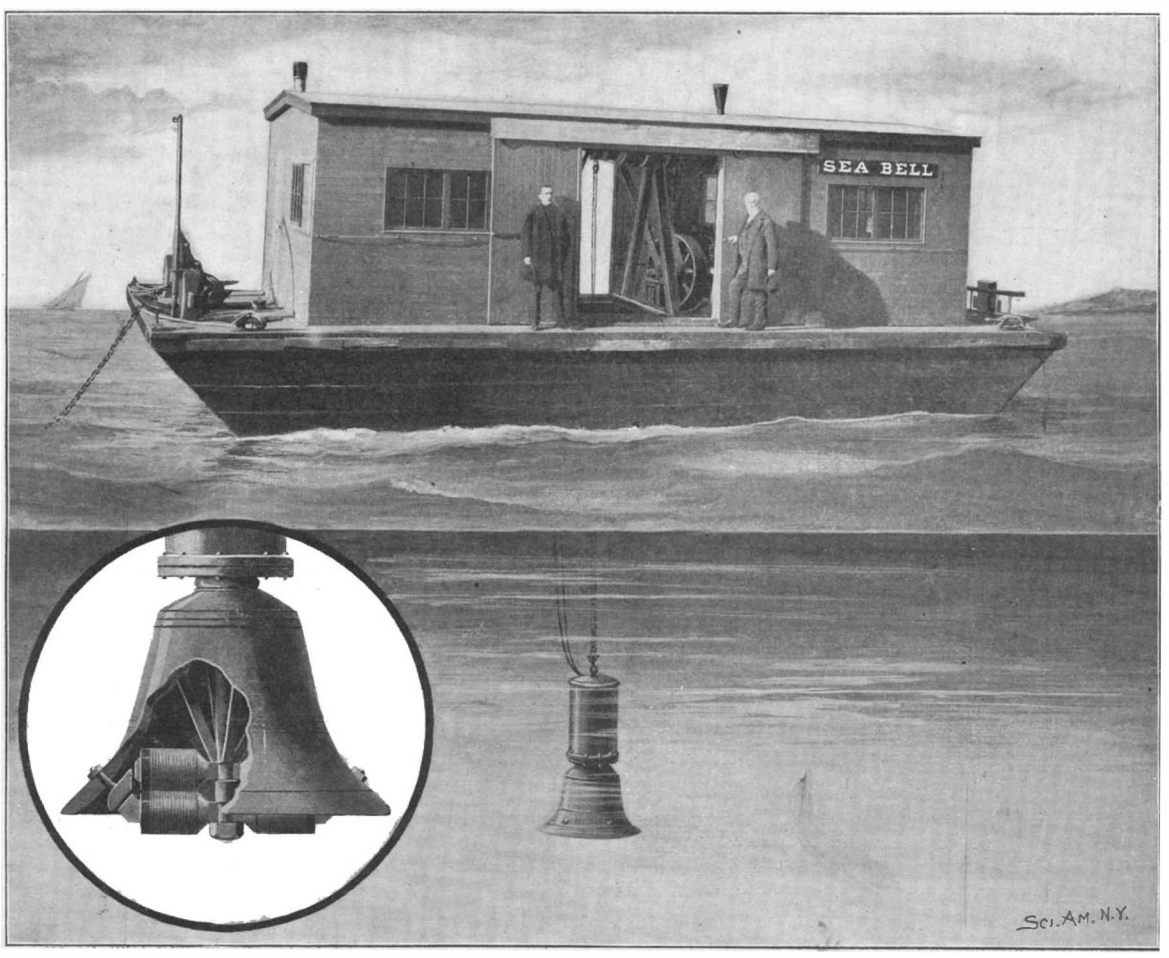
For greater distances Prof. Gray invented an electrical sound receiver. From this submerged instrument a connection is made to any part of the ship—say, the pilot house—where the navigator will listen for the sound through an ordinary telephone receiver.

A practical test of this apparatus was made on the last day of the century just ended. Several gentlemen were invited to witness the results accomplished. Among those present were Mr. Henry M. Whitney, who has given the enterprise his hearty support from the start; Prof. Wallace C. Sabine, of Harvard, an expert in acoustics; and Commander Arthur P. Nazro, U. S. N., Lighthouse Inspector. The "Sea Bell" was anchored in the open sea off Winthrop Head, near Boston Light, and the steamer having the party on board proceeded seaward. These gentlemen testified to having heard the submerged bell.

At 1½ miles the sound of the bell was very loud and very distinct; at 4 miles the sound was quite as distinct and almost as loud as at 1½ miles; at 8 miles the sound was quite as distinct as at 1½ miles and almost as loud as at 4 miles; at 12 miles the sound was heard at times quite distinctly, and at times somewhat feebly. Even at 12 miles the sound received was sufficient to give a practicable warning signal. It has been thus demonstrated that sound may be produced in the water at a given point and picked up electrically at any point within a radius of twelve miles.

It is now proposed to install a practical working station for the use and benefit of shipping entering and leaving Boston Harbor, in order that the great utility and value of the system may become known. Two bells, of different pitch, will be anchored one on either side of Boston Light, 50 feet below the surface of the sea. These bells will be, say, five miles apart, and each bell a mile or more from shore.

The bells will not be suspended from boats as here shown, but from submerged buoys, holding them up, and anchored to moorings holding them down, so that their position will be fixed and unchanging and properly charted. The electric power for ringing them will be supplied by insulated cables from the shore. They will be rung automatically from the power house at regular intervals, just as a flash-



SUBMARINE SIGNALING.

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light is operated in a lighthouse. They will be rung simultaneously at the beginning of each minute, and at the end of 20 seconds bell No. 1 will sound one stroke, and 20 seconds later bell No. 2 will sound two strokes, each bell thus declaring its identity.

Prof. Gray invented an electrical receiver to determine the direction of the origin of the sound. It therefore becomes a simple task to draw two lines on the chart at the ascertained angles, one from each charted signal bell, and where these two lines intersect there will be the position of the ship.

Prof. Gray invented an improvement by means of which his electrical receiver operates automatically a gong in the pilot house whenever the ship comes within a given distance of one of the submerged bells. Thus a submerged bell placed near a dangerous reef would set up an automatic alarm on board any ship thus equipped the moment she came within the radius of danger. This device would have saved countless lives and thousands of vessels which have been lost by getting out of their course and going to destruction when their commanders were off their guard, because they thought themselves perfectly safe.

It is, of course, obvious that vessels equipped with both sound-producing and sound-receiving apparatus may avoid collision, and send and receive intelligible messages to and from each other when they meet at sea. Also that lightships may be put in communication with shore stations, and that vessels passing along the coast may likewise send and receive messages to and from the shore.

Gray and Mundy patented a bell which is rung electrically, but without being struck percussively. Nothing touches it as it hangs motionless in either the air or water, but by depressing a common Morse key an electric circuit is made, which sends an alternating current to electro-magnets contained in the cavity of the bell, as shown in the detail view, and the magnetic lines of force thus created vibrate the bell continuously as long as the current is maintained, causing it to sound forth like a great organ pipe, but with tremendous power.

The successful ringing of a bell by this method depends upon sending precisely the proper number of impulses to the electro-magnets, and this in turn depends upon maintaining an absolutely uniform rate of speed in the motor driving the generator. The slightest change of speed will silence the bell. Prof. Gray could find no governor sufficiently sensitive to hold the speed uniformly to the rate called for by the fundamental tone of the bell; he therefore invented a device for this purpose. It is efficient and simple.

VIII. MERCURIAL BAROMETER.

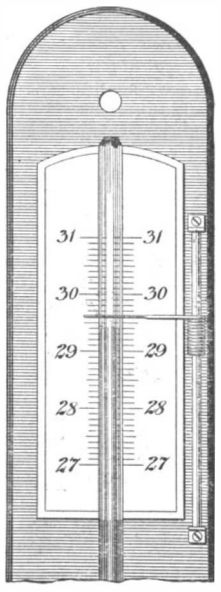
BY GEORGE M. HOPKINS.

The variations of atmospheric pressure are shown by the barometer. The pressure of the air in round numbers is 15 pounds per square inch; that is, a column of air 1 inch square, the height of the atmosphere (which is not positively known), weighs 15 pounds, and will balance a column of water 1 inch square and 34 feet high, or a column of mercury 1 square inch in area and 30 inches high.

A mercurial barometer is here shown on account of facility of construction and the accuracy of its operation. To make the simplest form of mercurial barometer, a strong glass tube a little more than 33 inches long and about 3-16 inch internal diameter is required. It must be sealed at one end, and left open and contracted to ⅛ inch at the other. This work is readily done by a glass blower. The open end is fused to remove the sharp edges. A small glass bottle is provided, the body of which is about 1 inch internal diameter and 1½ inches high. The neck is short and a little larger internally than the outside of the tube A board ⅞ inch thick, 3 inches wide and 39 inches long has a shallow half-round groove to receive the glass tube, and two brass straps extend over the tube and are clamped to the board by means of screws. Near the bottom of the board a hole is cut for the glass bottle or cistern, as it is called; a small shelf is secured by screws to the back board, even with the lower side of the hole in the board. A small hole is made in the back board near the top to receive the nail or screw upon which the instrument hangs.

Of course all the parts will be tried in place before attempting to fill the tube with mercury.

The tube must be perfectly clean, and only re-distilled mercury should be used. In the bottom of the glass bottle is placed a layer of pure beeswax 1-16 inch thick. The wax is made smooth and level by melting it by gently heating the glass bottle over an alcohol or Bunsen gas flame. When the wax is cold the filling of the tube with mercury may be proceeded with. The tube and the mercury are first warmed by passing them over an alcohol or gas flame; then mercury is poured into the tube through a small paper funnel. The tube should be filled to within ½ inch of the end with mercury. Then the clean, dry forefinger is held over the open end of the tube and the tube is placed in a horizontal position and tilted one way and then the other, to allow the bubble of air to gather up as much as possible of the air contained in the tube. The tube is then placed open end up and entirely filled with mercury. It is then inverted while it is kept closed by the finger. The end of the tube is placed below a body of mercury in a suitable vessel and a little of the mercury is let out so as to produce a partial vacuum at the top. Then the tube is closed and again turned into a horizontal position and tilted in one way and then the other, and at the same time turned or rolled over so as to cause the bubble to gather up any air

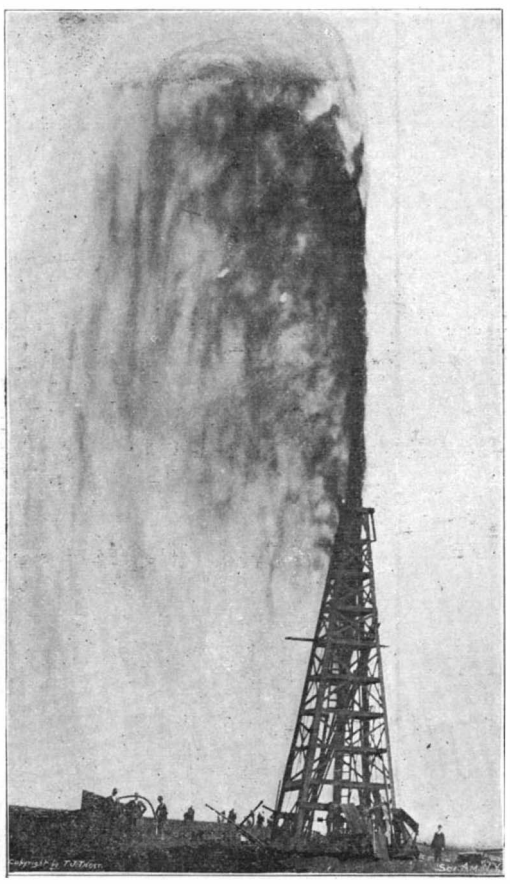


SCALE AND INDICATOR.

MERCURIAL BAROMETER.

that may remain. The tube is again inverted and filled, until it is entirely full of mercury. The finger is again applied, and a vacuum is produced by allowing a small amount of mercury to escape, when the tube is vertical as before. It is closed and tilted, allowing the bubble to again gather air. This operation is repeated two or three times. The tube is finally inverted and filled with mercury, so as to present a convex surface above the open end of the tube. The glass bottle containing the wax is placed over the open end of the tube and pressed down, causing the wax to make a good contact with the end of the tube.

The bottle is held firmly in place by the finger, and



THE BEAUMONT OIL WELL.

the bottle and the tube may now be inverted together, and after putting a little mercury in the bottle, the latter may be placed on the shelf prepared for it, and the tube may be raised a little, so as to clear its open end from the wax, and the tube is fastened in place by clamping it with the brass strips and screws. More mercury is added to that in the bottle so as to make the depth about ¾ inch above the lower end of the tube. A quantity of clean cotton wool is placed in the mouth of the bottle around the tube, to exclude dust, at the same time to admit air freely. The barometer is now finished with the exception of the scale.

A scale of inches ¾ inch wide and 4 inches long is laid out in the center of a card 2½ inches wide and 6½ inches long. Each inch is divided into tenths, and the divisional lines for the inches and half inches are extended beyond the ¾ inch limit. The beginning of the scale is numbered 27. The upper end of the first inch is numbered 28, the second inch is numbered 29, the third inch 30, and the fourth inch 31. The scale is placed behind the tube and the division line corresponding with the line at the top of the mercury in a standard barometer is placed in the same position relative to the mercury, and fastened by small tacks.

To enable the observer to mark the height of the column of mercury, so that he may compare the present observation with the previous one, an indicator is provided, which consists of a rod supported by posts attached to the board, and a short section of spiral spring placed on the rod, with the upper extremity straightened and extending over the barometer tube. This end of the wire is flattened by hammering to make a more delicate index.

In a general way the changes of the barometer are given, but they must be taken with some allowance. High winds and storms usually follow the sudden drop of the mercury. The rising of the mercury generally indicates fair weather; the drop of the mercury indicates bad weather. The fall of the mercury in sultry weather is followed by thunder; the rise of the mercury in winter indicates frost. In frosty weather the fall of the mercury precedes a thaw, and the rise is followed by snow. Sudden changes in the barometer indicate similar changes in the weather. Continued foul weather may be expected if the mercury falls slowly; on the contrary if it rises slowly continued fair weather may be looked for. Changeable weather is indicated by an unsettled barometer.

It is perhaps unnecessary to caution the maker of the barometer to conduct the various operations of filling and adjusting above a large platter or piece of smooth paper, with the edges turned up to avoid unnecessary waste of mercury.

THE BEAUMONT OIL WELL.

The well at Beaumont, Texas, has the reputation of being the largest "gusher" yet located in the United States. It is estimated that fully 150,000 barrels of oil escaped from it before the flow could be controlled. Already a large territory in its vicinity has been sold to oil companies, and it is probable that the country between Beaumont and Corsicana will be thoroughly exploited within the next year by prospectors.

The well was struck on January 10, 1901, by Capt. A. F. Lucas, a geologist, of Washington, D. C., who has been prospecting for oil in this section of Texas for about two years.

While the men were at work on the derrick they noticed a commotion in the well, and hastily retiring had no sooner reached a safe distance when the well burst with a terrific noise, and 600 feet of four inch iron pipe was shot from the well and sent 600 feet into the air. The pipe was followed by hissing gas and oil which spouted 150 feet into the air. Almost immediately the stream settled down to pouring out pure oil, and from that time until the evening of January 16 the solid stream of oil continued to pour without a particle of diminution into the air. On January 18 the flow of oil was well under control. It fell to ground in a mist and ran off in a small river into a ravine or valley below, where it formed a lake which was ultimately overflowed and the oil continued down the regular watercourses to the Gulf of Mexico. The stream of oil is six inches where it issues and spouts fully 150 feet high in a solid body, then sprays. Experts have estimated that it flowed 20,000 barrels of oil every twenty-four hours. The oil has a specific gravity of about 24 degrees and is a good lubricating grade.

The mayor of Toledo said in relation of this well to the oil industry, after an examination of it:

"I think it the greatest oil well ever discovered in the United States. It is fortunate, for the oil trade, that it is not illuminating oil. If it were it would paralyze the entire industry. Its advent, however, means that liquid fuel is to be the fuel of the twentieth century. Smoke, cinders, ashes and soot will disappear along with war and other evidences of barbarism. The new oil well means a cleaner as well as a better civilization.

"Practically the only market for it is for fuel and road making. Texas should use millions of barrels for the latter purpose. Both these markets, however, must be created, and this means that before a market can be established two things must be demonstrated beyond question: first, that there is a great area of oil-producing territory and that the supply is inexhaustible, and this can only be done by drilling many wells; second, after the fact of the existence of the territory is demonstrated, it will be necessary to secure the confidence

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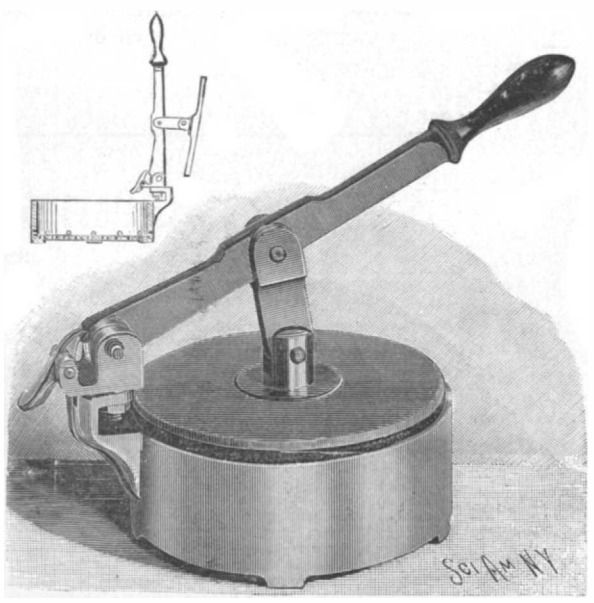
of the consumers of fuel oil, and this can only be done by the accumulating of a stock of from 10,000,000 to 40,000,000 barrels on top of ground in iron tanks. This means an investment of millions of dollars and systematic organized effort for several months, possibly a year or two, before this oil market is firmly and satisfactorily established."

PRESS FOR PREPARING FOMENTATIONS.

The inconvenience and difficulty of preparing bandages for fomentations by hand are overcome by a simple press which has been invented by Mrs. Mary Jordan Smith, of New York city, and which performs its work far more effectively than would otherwise be possible. The making of the press has been undertaken



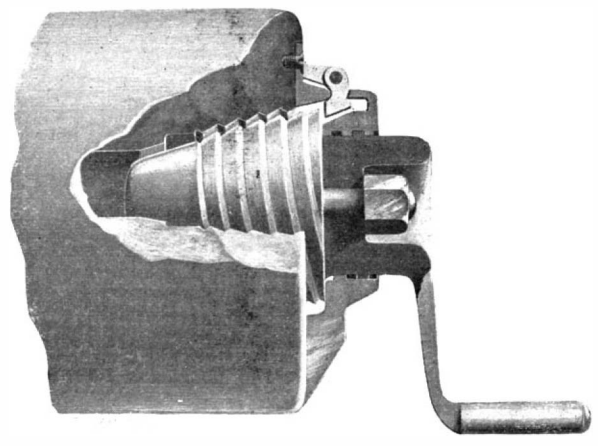
PRESS FOR PREPARING FOMENTATIONS.

by George Tiemann & Co., 107 Park Row, New York city.

As shown in our engraving, the press is composed essentially of three parts—a receptacle, a lever and a pivoted plunger carried by the lever. The bottom of the receptacle is perforated to permit the escape of water. The lever is mounted on a bracket to swing both in a circle horizontally, and up and down, so that the plunger may be either depressed in the receptacle or raised and carried to one side.

In service, the bandages having been placed in the receptacle, hot water or any medicated solution is poured over them. The lever is then swung around to bring the plunger over the bandages. By pressing downwardly on the lever, the plunger is made to force water out of the bandages, through the perforated bottom of the receptacle. In order to prevent an upward movement of the plunger when the lever is released, a spring-pressed detent is employed which is pivoted on the bracket and which coacts with teeth on the pivoted end of the lever. After the surplus water has been expressed, the detent is released and the lever swung up and aside in order that the apparatus can be carried to the bedside and that the bandages can be readily removed.

The advantages of the invention are obvious. The hands need never come in contact with the bandages during the operation of the device. The bandages, retained as they are in the receptacle and thus carried to the patient, retain their heat for twenty minutes, a result which testifies to the efficiency of the instrument. In preparing fomentations, it is the custom to bring to the bedside the several utensils which are required. Not only is the fomentation prepared with difficulty, but the moral effect of the utensils on the patient is often harmful. The press described simplifies the preparation of fomentations by dispensing with these utensils and enables a bandage to be prepared without the knowle the patient.



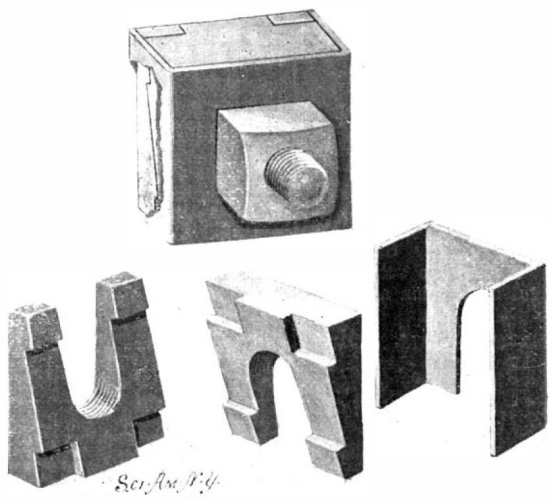
A DOUBLE-THREADED BREECH-PLUG.

NOVEL INVENTIONS RECENTLY PATENTED.

Sometimes it happens that a bolt cannot be removed or that a much-worn thread prevents a removal of the nut. For such emergencies Alfred S. Seaman, of Frackville, Pa., has invented a simple relief-nut, which also serves as a washer and as a time-saving device for fitting a new washer or nut without stopping the machinery. The relief nut is substantially composed of two wedge-shaped nut-sections, slotted from their ends to form arms. The free ends of the arms of these sections have hooks, which interlock with seats on the opposite ends of the abutting section, so that the sections embrace the bolt. When they are applied and fitted tightly, the relief-nut sections can be removed only by releasing or turning the bolt-nut outwardly. A flanged cap is fitted over the relief-nut and forms a bearing for the bolt-nut and a retainer for the relief-nut sections. The device can be applied to the head-ends of partially-worn foundation-bolts and other bolts under great strains. The improvement can also be used when the bolt is battered or riveted, or when the thread is stripped or does not extend to the surface against which the nut is to be turned.

A very simple and ingenious improvement in breech-blocks has been devised by John F Meigs and Sigard A. S. Hammar, of South Bethlehem, Pa., which improvement not only strengthens the connection between breech and plug, but also increases the rapidity of fire. The plug is formed with a continuous, tapering multiple thread, instead of with the usual "interrupted screw," whereby very important results are obtained. With a double thread, for example, less longitudinal and consequently less angular movement is required than with a single thread of the same pitch. The height or projection of the double thread is half that of the single thread; and hence it is necessary to move the plug longitudinally only half as far to free its thread from the breech. The swinging-plate by which the plug is carried is provided with radial pins for engagement with a thread in the carrier-opening. The pitch of the thread is the same as that of the plug until a point is reached in the rearward travel of the plug, when the plug-thread is disengaged from the breech. The pitch of the thread in the carrier-opening then increases. The purpose of this arrangement is to accelerate the movement of the plug after it has been cleared of the breech.

In the ordinary construction of preserve-jars, when the cover is screwed on the neck, the air remaining within the jar is compressed, thereby leaving a space between the preserves and the cover. In this space mildew usually collects. Moreover, it is necessary to heat the preserves to a high temperature in order to expel the oxygen. These evils of the ordinary preserve-jar are remedied in an invention which has been

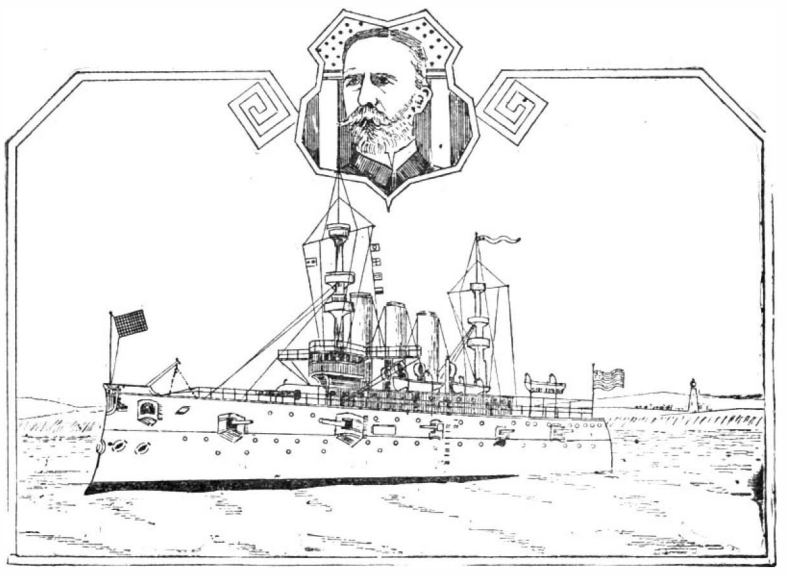


A SIMPLE RELIEF-NUT.

patented by Henry W. Woolbert, Box 690, Pittsburg, Pa. The accompanying illustrations represent two forms of the new jar. The body of the jar is flanged to receive a rubber ring upon which the flanges of the cover bear. The concave center of the cover is provided with a small cup in which a plunger is contained, operated by a cam-lever. A valve in the plunger permits the escape of air from the jar, but prevents the entrance of air into the jar. By operating the cam-lever the air in the jar is partially exhausted, so that the heat required to expel the oxygen is considerably less than would otherwise be necessary. In Fig. 2 a bell-crank lever is shown instead of the arrangement described. It will be seen that the invention consists essentially in applying a miniature vacuum-pump to a preserve-jar.

PICTURE MAKING ON THE TYPEWRITER.

The accompanying engraving of Admiral Sampson and his flagship the "New York" was reproduced from an original picture measuring 8 inches in height by 11 inches in width, which was made entirely on a typewriter. At first sight one would be tempted to deny that such a result could be obtained, except by the use of some special type, which had been arranged to make impressions through the manipulation of the key-board; but as a matter of fact, the original drawing was made by A. Roeder, Jr., of Baltimore, entirely by the aid of the standard characters which are to be found on the Densmore typewriter. If the picture be closely examined, it will be found that the straight lines and curves with which the ship is built up are formed by ingenious combinations of the various letters and characters shown on the key-board. The horizontal and vertical lines were obtained by the use of the shift, underscore, etc., the curves were obtained by using the parenthesis, the apostrophe, etc. Thus, the two hawse-holes for the anchor chains were formed by using the signs of the parenthesis and the acute accent. The portholes were made by using the sign for a degree. In the signal flags we see the use of the asterisk, the degree sign, the hyphen, etc., while the flag at the stern of the vessel is made by the use of the parenthesis and the period. It will be understood, of course, that the paper on which a picture of this kind is made has to be constantly twisted to different angles in order to get the desired lines.

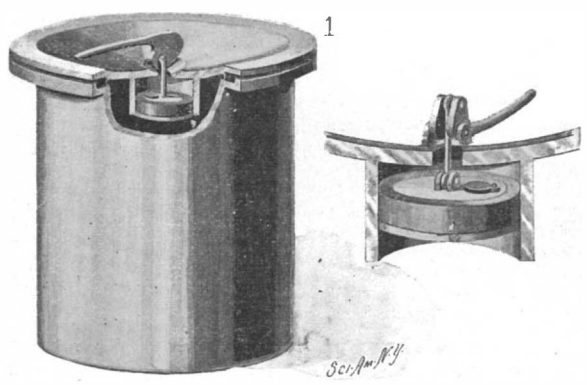


ADMIRAL SAMPSON AND THE "NEW YORK."

This picture was made on the typewriter by the use of the regular characters and signs.

The Current Supplement.

The current SUPPLEMENT begins with a portrait and biographical notice of the late Queen Victoria. "Archæology" (in the last century) is by Prof. W. M. Flinders Petrie, D.C.L., LL.D., and deals with archæology in Syria, Greece, Italy, India, and America. It is an article of the greatest possible importance. "Meteorological Instruments," by Prof. Hans Hartl, is accompanied by twelve engravings. "Recent Science," by Prince Kropotkin, is concluded. "A New Page-Printing Telegraph" is by William N. Vansize, and describes the epoch-making invention of Donald Murray. A fully illustrated article on "The Colwell Rotary Engine, Reciprocating Engine and Condenser" is also included in this issue.



A VACUUM-PUMP FOR PRESERVE-JARS.

Contents.

(Illustrated articles are marked with an asterisk.)

Automobile news	70	Preserve jars, vacuum pump*	75
Barometer, mercurial*	74	Press for fomentations*	74
Breech-block, double-threaded*	75	Railway, elevated underground*	69
Columns, basaltic*	68	Railways, steepest in the U. S.*	70
Cycle show*	73	Relief nut*	75
Electrical notes	71	Saw-setting machine*	68
Elevated, Boston*	69	Science notes	71
Engineering notes	71	Signaling, submarine*	73
Flying machine, new*	72	Tesla's light	67
Gray, death of Prof. Elisha*	72	Trade marks registering	66
Heavens in February	67	Trolley car funeral	67
Naval bill	66	Typewriter, picture making on*	75
Oil well, Beaumont*	74	Victoria	66
Phosphorus, electrolytical prep	66	Yacht racing and the towing tank	66

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RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

PHOTOGRAPHIC SHUTTER.—Gassner F. Fraley, St. Louis, Mo. In this improved device a finder is employed which shows the image as it is produced by the same lens which effects the exposure. A portion of the finder is utilized for the operation of the shutter. Simple mechanism has been devised for obtaining at will either snap-shots or time exposures.

CRUSHER.—Edward D. Chester, 120 Bishopsgate Street, London, England. In this ore-crusher a crushing-cone is carried by an upright spindle and is caused to gyrate within a conical crushing-hopper or "concave." Motion is communicated to the spindle by means of a driving-wheel mounted to rotate with the crushing-hopper and provided with an eccentric aperture through which the spindle passes freely. The spindle is held at the top in alinement with the crushing-hopper and with the driving-wheel, and is supported at the bottom upon a footstep bearing, affording freedom for the gyratory movement of the spindle. The novel features of the invention are the means for adjusting the position of the crushing-cone vertically within the crushing-hopper, so that the size to which the material is crushed can be regulated, and the means for enabling the whole mechanism whereby this adjustment is effected to be readily removed for cleaning or repair.

WRENCH.—Thomas F. Mooney, 1305 Valley Street, Baltimore, Md. The wrench can be applied to the nut with its jaws open and can be caused to close automatically upon the nut, thus furnishing a quick-acting wrench which can be conveniently manipulated with one hand. To this end the jaws are supported so that they can move toward and from each other. Cams or inclines are used for engagement by the jaws and means for moving the jaws and cams or inclines relatively, so that the cams or inclines will cause the adjustment of the jaws toward or from each other.

WRENCH.—Danton O. Brunner, Somerset, Ohio. The wrench is to be used either as a pipe or nut wrench. The principal novel feature of the invention is the employment of corrugated or toothed roller bearings in the jaws, so placed that when the wrench is in action the bearings will have a gripping engagement with opposite sides of the nut or pipe.

WRENCH.—Reginald Meeks, Manhattan, New York city. The shank of the wrench carries a pinion for engagement with a rack attached to the handle and with a rack carried by the movable jaw. By simply moving the handle longitudinally with relation to the fixed jaw, the wrench is quickly adjusted to suit the size of the nut. No screw-threads, adjusting-nuts, or swinging levers are employed.

Engineering Improvements.

ELECTRIC IGNITER FOR EXPLOSION-MOTORS.—Charles E. Lufbery, Chauny (Aisne), France. This electric igniting device for explosion-engines includes an interrupter, having two wires, one of great resistance and the other of low resistance. The wire with great resistance is always connected with the source of electricity. A circuit-breaker controlled by the engine is connected with the low-resistance wire. An induction-coil and its primary coils connect it with the circuit-breaker and the wire of high resistance; the secondary coils are connected with the igniter. The source of electricity is a dynamo which is employed in connection with an accumulator. By means of a switch either the dynamo or the accumulator can be shunted in or out or the accumulated charge from the dynamo to furnish the current for ignition. The igniter, it is claimed, is almost infallible in its operation.

VALVE MECHANISM.—Isaac L. Fitz Hugh, Picolata, Fla. This rotary main valve has annularly arranged inlet-ports and an exhaust-recess. An eccentric moves the main valve on its seat. A cut-off valve over the main valve regulates the admission of steam from the steam-chest to the inlet-ports. The cut-off valve is mounted on an eccentric, which cut-off valve eccentric is under the control of the operator to shift the cut-off valve over the face of the main valve to the desired point of the cut-off.

Railway Appliances.

MAIL CATCHING AND DELIVERING FRAME.—Francis C. Kilby, Richmond, Mo. This invention is a device for catching mail-bags at a station from a passing train and for delivering mail-bags to a passing train. At a station a crane is mounted, the arm of which is provided with divergent bars. Carried by the mail-car is an angle-arm designed to pass between these divergent bars. A ring is attached to the mail-bag, which ring, and consequently the bag is caught by the crane-arm as the car rushes by.

WATER-GLASS SHIELD. — Edward T. Reed, Port Jervis, N. Y. The shield is designed to be used in connection with the gage-glasses of locomotive-engines for the purpose of preventing the engineer from coming in contact with the glass and to protect him from flying pieces of glass and from steam or hot water, should the gage break. The water-glass is partially surrounded by a water-glass shield engaging the gasket-nuts. Clamping-yokes also engage the shield. A mirror is mounted to swing on the yokes, which mirror is designed to reflect the water-glass, so that the level of the water may be observed by the engineer at any desired point.

Miscellaneous Inventions.

DOOR-STOP. — Durward B. Hampton, Napa, Cal. The improved door-stop consists essentially of a baseboard member and a door member. The baseboard member is hollow and is provided with a rubber socket having a conical head through which the button-head on the door must pass. When the door is open and the button has engaged the socket, the stopper acts as a cushion for the door, so that the engagement of the two members is rendered noiseless and the two securely locked together.

MAIL-POUCH.—Jasper N. Tabler, Royse City, Texas. The inventor has devised an extension-top for mail-pouches, and a simple, quickly-operated, and secure fastening device for the mouth of the extension-top. He has, furthermore, so applied the extension-top to the body of the pouch, that when the mouth is locked, the extension-top and its fastening device will drop within the body of the bag, the top portion of which body may be held closed by auxiliary devices. The locking device is protected; the bag is easily handled; and the fastening device enables the bag to be quickly locked or unlocked. An ample opening is provided by the extension-top for the reception of mail matter.

ALARM FOR REFRIGERATING-PANS.—George N. Enners, Brooklyn, New York city. The purpose of this invention is to provide a simple alarm for the drip-pans of refrigerators, which alarm is so constructed that when the water in the pan reaches a certain level, an alarm will be actuated. The device by which this purpose is attained consists essentially of a float having guided movement in the pan, which float is made to engage the push-button of an electrical alarm when the water reaches a predetermined height.

BOX-FASTENER.—Sofus Raaen, Aalborg, Denmark. This fastening device for two parts of cases and other articles, comprises a link pivoted to one of the parts, and a locking-bolt mounted to slide on the other part transversely of the link and adapted to engage the latter. A stop-lug prevents the sliding movement of the lug. By means of this device a cover or lid can be firmly secured without the use of nails, screws, or any special lock.

BUCKLE.—George W. Potter, Jr., Fayette, Mo. This buckle for use on harness is in the nature of a tug-buckle and trace-carrier combined. The buckle is suitably secured to the strap leading back from the hames, is supported by the back strap of the hames, and is composed of top and base plates. The tug is inserted between the top and base plates; and the tongue of the top plate is inserted in the proper hole of the tug. The buckle cannot jar loose or the tongue become otherwise accidentally released from the buckle.

FLOAT-VALVE FOR WATER-TANKS.—John Morrison, Dubuque, Iowa. The improved valve is designed for automatically controlling the flow of water in reservoirs, tanks, cisterns, and the like. The valve is operated by a lever or two levers, as the case may be, and is connected with a rocking or rotatable disk, having a stop to limit its movement. The valve engages a hooked post fixed on the valve-seat and is guided in its movement without appreciable friction.

ADJUSTABLE SCHOOL-CHAIR.—Experience L. Sauder, Philadelphia, Pa. The object of the invention is to provide an improved adjustable chair for use in connection with school-desks. The chair is distinguished by its simplicity, cheapness, and strength. A hollow pedestal has interior ribs or projections, one of which is located near the top and the other diagonally opposite. A clamp screw is arranged directly below the upper rib and at a lower point on the second rib, whereby the post is held by friction and pressure at three points.

FOLDING TABLE.—Simon M. Snook, Scranton, Pa. The folding table comprises a pair of crossed legs connected by a reach. This reach consists of parts pivotally joined and adapted to fold one into the other. The upper ends of the reach parts are pivoted to the upper cross bars of the legs. Braces are pivoted to the reach parts and are adapted to lock on the lower cross bars of the legs. A catch on one of the reach-parts locks the other reach-part in position when folded. The table-top is supported on the legs by means of hooks engaging staples on the cross-bars.

PROCESS OF PAINTING DESIGNS ON SURFACES.—Edward S. Martin, Media, Pa. This process of producing ornamented surfaces on glass, wood, and other materials, consists in spraying, by means of heated compressed air, varnish, alcohol, and ether upon the surface to be ornamented, and at the same time subjecting the article and the varnish to heat so as to produce a uniform deposit of the matter on the surface to be ornamented.

CARBURETER.—Edward J. Kern, Jackson, Mo.—This invention provides a carbureter for generating gas from hydrocarbon oils On an oil-tank a dome is mounted; and in the tank a bell is movable, having perforations near its lower end, held below the level of the oil in the tank. A cork bottom is provided for the bell. An air-pipe leads into the bell; and a gas-distributing pipe leads from the tank. In this carbureter the bell is practically at all times kept at the same level in the oil as the oil sinks in the tank. Therefore, the point of saturation remains the same until all the oil has been used. A pure clear gas is generated, which is ignited without heating the burners by means of alcohol.

TEMPORARY BINDER. — Charles V. Henkel, Manhattan, New York city. The purpose of this invention is to provide a temporary binder which may be readily adjusted to suit the thickness of the papers, thus rendering the capacity of the binder variable according to the number of papers it is desired to file. The binder has a filing-post made up of stationary end sections, and removable intermediate sections. The intermediate sections comprise each a tubular part and a reduced part at the other end. These tubular parts have projections formed on their inner faces; and the reduced parts have grooves, which coact with the projections to lock the sections together.

HOLDER FOR WAX, PARAFFIN, STEARIN, ETC.—Guido Hecker, Manhattan, New York city. This novel holder is designed for use in laundries, and in bicycle or machine shops for the application of polishing material to flat irons or of lubricants to leather and woods. The holder employed comprises a hollow body portion, having a closure at one end, provided with a central opening. A plunger moves in the body portion. A stem extends from the plunger through the opening. For one end of the body an open-mesh cover is employed, the cover having its edge fixed to the outer surface of the body and covered with a label.

EARTH-AUGER.—Nils H. Hansen, Westport, Wash. The earth-auger has a hollow body forming a bucket, which body has an exterior spiral thread, at the upper extremity of which is a recess. A shoulder is located at one side of the recess to deflect the earth sidewise through the recess into the body. The auger is adapted for use as a prospecting instrument as well as for piercing soft earth and quicksand.

SHUTTER ATTACHMENT. — George J. Eppright, Manor, Tex. To provide means for holding the slats of a window-shutter open, a spacer is employed which is so mounted as engage the side faces of two or more slats. The invention is applicable to the ordinary shutters which have horizontal slats pivoted and connected with a bar by which the slats are opened and closed.

PAPER BOX.—Carl Engberg, St. Joseph, Mich. The inventor has provided a new and improved paper box made from a single blank. The blank is so cut that the sides of the finished box are but slightly inclined upwardly and outwardly, while the ends are inclined upwardly and outwardly to a greater extent than the sides, thereby giving the box a very neat appearance. The ends and edges are reinforced so that great strength is imparted to the box.

DOOR-HANGER. — Richard B. Browne, Brooklyn, New York city. The door is suspended by a number of pulley-brackets upon a track-rail, so that it may be moved with ease along the track-rail. The invention is an improvement on a door-hanger for which Mr. Browne has already received a patent. By reason of these improvements the door-hanging device operates more efficiently without materially increasing the cost of production.

BEAM.—Herbert J. Armstrong, Markdale, Ont., Canada. The patent describes a beam for use as a joist, girder, or the like. The beam has a web provided with a truss which may be either formed integrally therewith or fastened thereto, and which lies wholly within the area of the web so as to form a component part thereof. By reason of this construction lateral strength is imparted to the beam and buckling is prevented.

PAD-CLIP.—Paul W. Beech, Memphis, Tenn. Attached to a base are a gripping member having teeth, and a rail extending at right angles to the fixed gripping member. On this rail a second gripping member is mounted to slide, which is held in proper position by a clamping device. The pad-clip can be so adjusted as to hold various sizes of pads firmly, and yet so that several leaves may be torn off or removed without interfering with the adjustment.

COMPOSITE BOTTLE.—Alphons Dryfoos, Manhattan, New York city. The bottle is composed of three sections forming together a single body. A cover incloses the sections, which cover is provided at its upper end with a neck serving as a handle for the body and as a means of preventing an upward movement of the section. The cap is provided with passages for the escape of the contents of each of the sections.

Designs.

ELECTRIC-LIGHT FIXTURE. — William McConnell, Brooklyn, New York city. The electric-light bulb is inclosed in a flower carried on the end of a stalk apparently growing from a jardinière.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(8033) J. E. P. asks: What is the length of life of a storage battery for lighting, if charged each day? A. There is no such thing as "length of life" of a storage battery. Theoretically, it should last forever; practically, it may break down to-morrow. Much depends on the rate of discharge. Too rapid a discharge injures the plates. See Tredwell's "Storage Battery," price $1.75, by mail, or Salomon's "Accumulators." price $1.50 by mail.

(8034) J. G. asks: What is the electro-chemical equivalent of zinc? A. The electro-chemical equivalent of zinc is 0.00033698 in grammes per coulomb. See Thompson's "Elementary Lessons," price $1.40 by mail. 2. Can commercial zinc be deposited chemically pure by the electric current? A. Yes. A plate of commercial zinc is made the anode, and the zinc is deposited pure upon the cathode. 3. What is the best depositing solution; how concentrated should it be; how many amperes should flow per unit area? A. A good plating solution is sulphate of zinc, 2.8 ounces; water, 1 quart; ammonium sulphate, 1¾ ounces; sal ammoniac, 1⅜ ounces. The salts are dissolved in the water heated. The bath is used at 68 deg. F. The current from two or three Daniells' cells will be sufficient.

(8035) H. L. C. writes: 1. Please tell me how to proceed with experiments in electroplating with battery. I have some of the two-cell kind. A. If you wish to electro-plate as an experiment in electricity, almost any text-book in physics will show you how to proceed. If, however, you wish to plate for use, you would better buy Watts' "Electro-Plating," price $1 by mail, a book which describes the work and processes with various metals. 2. How many I find the strength of such batteries? A. The voltage of batteries is measured by a voltmeter, and the amperes by an ammeter. Simple forms of these instruments are described in the Supplement No. 1215, price 10 cents. 3. Would an induction coil add more current? A. No. An induction coil does not generate or produce any electricity. It only transforms in its character the current which passes into it. It may be so arranged as to raise its voltage, or else to lower the voltage. If the voltage is raised, the amperes are correspondingly reduced, and vice versa. 4. How could I construct an induction coil? A. An induction coil giving a short spark is described in Supplement No. 160, price 10 cents.

(8036) H. D. W. asks: I have a small telephone magneto which I have wound with wire, about No. 20, and put on a commutator. The magneto gives fair power when running at about 500 revolutions, but when running faster the power diminishes. Why? What should I do in order to make the power increase as the speed? Having a water motor and a water pressure at about 90 pounds, I think the motor would make something over 2,000 turns when running full speed. Should I put on heavier or finer wire, and how much? A. We know no electrical or magnetic reason why the current should decrease after a speed of 500 turns per minute is reached. Perhaps the contact of the brushes is not so firm at higher speeds, due to unevenness of the commutator. The size of wire you should use depends on the voltage for which you are planning. You can

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experiment and find what gives you the best results. We have no means of knowing what you will get.

(8037) A. A. asks: Would one solid piece of soft iron, say Norway iron, of proper size do for field magnet core for simple electric motor described in SCIENTIFIC AMERICAN SUPPLEMENT No. 641, instead of the strips of Russia iron, or are the strips better? A. Yes. The strips of iron are used in the motor because the plan is made for the benefit of those who have no tools for shaping iron. If one has a shop and tools, he can do better work and build a better machine.

(8038) H. L.—A dam lower down upon a stream cannot retard the water in the tailrace of another dam higher up the stream, if the back water of the lower dam does not reach into the tailrace of the upper dam.

NEW BOOKS, ETC.

SOILING CROPS AND THE SILO. By Thomas Shaw. New York: Orange Judd Company. 1900. 12mo. Pp. 366. Price $1.50.

This new book by Prof. T. Shaw forms a companion volume to his "Forage Crops," published last year. The book is divided into two parts, the first of which treats of growing and feeding of all kinds of soiling crops. The second part discusses the silo. The subject is treated in a simple and comprehensive manner. It is a plea for the silo by a sensible discussion of the place of the silo. All progressive farmers should have a copy of this book.

MECHANICAL TRIUMPHS OF THE ANCIENT EGYPTIANS. By Commander F. M. Barber, U. S. N., late Naval Attache. London: Kegan Paul, Trench, Trubner & Company, Ltd. 1900. 16mo. Pp. 123.

As the result of three visits to Egypt, it has been the author's experience that, notwithstanding the interest of travelers in the manners and customs of the ancient Egyptians and the nature of their stupendous monuments. the question most frequently asked with regard to the latter is not why did they create them, but how? How did they transport these great stones, and how did they lift them to the position in which they are now found? It has been the author's object in preparing this essay to solve the problem in a more complete manner than has yet been done, and to show what is actually known, and to suggest the most plausible theories. The author has produced a most attractive and readable little book, which is well printed and bound.

SPECIFICATIONS FOR STEEL BRIDGES TAKEN FROM DE PONTIBUS. By J. A. L. Waddell. New York: John Wiley & Sons. 1900. 16mo. Pp. 178. Price $1.25.

There is a considerable demand by draughtsmen and computers for the specifications of "De Pontibus," but that book is too expensive to use for specifications only, consequently the author and publishers of the work have concluded to print the said specifications, together with the tables and diagrams, separately from the other chapters; hence this little book, it is hoped, will serve the purpose of engineers at a third of the cost of the original treatise. It is a most admirable engineering treatise.

THE CHEMISTRY OF MATERIALS OF ENGINEERING. By A. H. Sexton. Manchester, England: The Technical Publishing Company. 1900. 12mo. Pp. 33.

For several years the author has given a course of lectures to engineering students on the materials of engineering, and he has felt the need of a suitable text-book for the class. To meet this need he has prepared the present volume. It covers the ground occupied by treatises which were beyond the reach of the ordinary student. The chemistry of iron, the manufacture of iron and steel, copper, lead, zinc, alloys, wood, stone, clay, mortar, cements, fuel, water, lubricants, paints and varnishes, are some of the subjects treated.

INORGANIC, GENERAL, MEDICAL, AND PHARMACEUTICAL CHEMISTRY. By Oscar Oldberg, Ph.D. Chicago: Medical Book Company. 1900. Two vols. 8vo. Pp. 522, 655. Price $7.

It was the chief aim of the author in writing this book to prepare for the use of his pupils a treatise on the pharmacy of inorganic chemistry, but this could not be accomplished without including in the book so much of general, theoretical and descriptive chemistry that the inevitable outcome is instead a treatise on inorganic chemistry of pharmacy, including an adequate discussion of the fundamental principles of general theoretical chemistry. The author's chapters dealing with elementary theoretical chemistry are particularly to be commended. We have rarely seen the basic principles of chemistry so well presented. It is a most admirable section of the first volume and occupies some 314 pages. The second volume is devoted to a laboratory manual and includes probably all inorganic chemical preparations of medicinal or pharmaceutical use and nearly all of commercial importance, together with many compounds introduced solely for the purpose of instruction. The volumes are handsomely printed in large type and good paper, and are worthy of a large sale.

MODERN ELECTRIC RAILWAY MOTORS. By George T. Hanchett, S.B. New York: Street Railway Publishing Company. 8vo. Pp. 300. Price $2.

This volume is a discussion of the current practice in electric railway motor construction, maintenance and repair. The trolley, both overhead and underground, has now displaced so thoroughly all other means of propulsion for street cars that any new and satisfactory books upon this subject are very welcome. The subject appears to be very adequately treated by the author. It is intended more particularly for those who have just entered or are about to enter active work in the electric railway field.

By almost the same mail we received copies of the January number of The Engineering Magazine and Cassier's Magazine, both of which are fine examples of modern journalism. The Engineering Magazine contains no less than 327 pages of reading matter, and in connection with the advertisements justly bears out the claims of the publishers that it is the largest single issue of any magazine. The number is what is called the "Works Management Number," and deals with such vast enterprises as the Elswick Works of Lord Armstrong, the huge enterprises built up by Andrew Carnegie, the founders of the Krupp establishments, George Westinghouse, inventor, organizer and director. Then follows a series of elaborate articles within the purview of the title.

Cassier's Magazine for January, while much smaller, is beautifully printed and illustrated. The interesting feature about it is that which is called the "library edition." That is, instead of having the usual paper covers like all other magazines, the library copy will hereafter be furnished in handsome cloth covers, printed on extra heavy paper. In this form each separate copy of Cassier's will be a substantial volume and the contents will be well preserved.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

JANUARY 22, 1901,

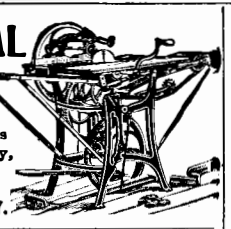
AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid, making picric, M. Neumann 666,627
Adding-machine, B. F. Canode 666,599
Adding-machine, J. H. Davis 666,499
Advertising, &c., apparatus for, H. B. Hopewell 666,524
Aerial navigation, machine for, J. H. Dillon-Gregg 666,266
Alkali, electricity, and hydrogen from alkali-metal amalgam, apparatus for producing, J. W. Kynaston 666,387
Angle-bar straightener, R. A. Blair 666,619
Animal-trap, J. B. Tompkins 666,625
Animal-trap, J. Wisecup 666,369
Ax-forging die, W. R. Wood 666,585
Bag-holder, H. H. Greene 666,516
Bag-holder, F. H. Wiard 666,296
Bale-band fasteners, turning-tool for, D. M. Campbell 666,492
Baling-press, S. J. Webb 666,293
Bearing boxing, ball, J. W. Dickinson, Jr.. 666,378
Bearing for agricultural machinery, wheel, L. Heath 666,420
Bed, folding, Harris & Andrews 666,521
Bed-spring support, S. Freund 666,505
Bell, pedal, Kuykendall & Kimball 666,386
Belt, H. Mehl 666,480
Bicycle-support, S. B. Parsons 666,550
Bicycle-support, A. Samuelson 666,358
Bicycles, adjustable crank-hanger for, C. von der Heyde 666,445
Binocular glasses, J. Aitchison 666,611
Boat-detaching device, life, J. Carnegie 666,600
Boiler-cleaning device, W. Chesterman 666,408
Boring-machine, automatic, J. W. Brown, Jr 666,486
Bottle, non-refillable, J. S. Haggerty 666,519
Bottle, water, J. Hurley 666,313
Brake mechanism, M. Q. Routan 666,562
Brick-carrying device, F. E. Sproat 666,331
Brush, folding, T. R. Shearer 666,360
Brush-handle, C. Klauberg 666,319
Buckle and snap-hook, combined, B. F. Van Camp 666,288
Buckle, belt, J. Ritter 666,285
Buckle, shoe, C. Klinger 666,320
Buoy, self-announcing, W. S. Bryant 666,259
Burglar-alarm and sash-lock, combined, J. G. Moser 666,542, 666,543
Button, upholstering, B. B. Fixen 666,503
Caisson, W. H. McFadden 666,388
Camera, A. P. Prentice 666,556
Can-capping machine, P. Swenson 666,572
Canners cooking-crate, W. A. Robinson 666,629
Candying fruit, W. J. Dunnachie 666,413
Cane mill, sugar, P. A. Cazes 666,377
Car bolster, railway, G. I. King 666,276
Car-coupling, automatic, H. G. Dunston 666,475
Car, dumping, R. D. Allen 666,589
Car fender, street, R. Thompson 666,399
Car heater, electric, E. E. Gold 666,418
Car-step, W. H. Perry 666,437
Car, storage-battery-transfer, G. H. Condict. 666,303
Car-window dust-guard, L. G. Clark 666,601
Cars, &c., safety device for tram, C. H. A. Meyer 666,539
Carbonating apparatus, liquid, G. D. Rhinehart 666,559
Carbureter, J. Wilkinson 666,483
Card-setting machines, tooth forming and inserting mechanism for, O. Arnold 666,370
Cartridge loader and reloader, W. W. Moore 666,540
Casting apparatus, iron, R. H. Wainford .. 666,367
Chain wrench, W. H. Burr 666,490
Chains, machine for making ornamental, W. I. Macomber 666,634
Chair fan attachment, rocking, O. Herrmann 666,310
Chimney-top, J. Wood 666,299
Chuck, Z. T. Furbish 666,507
Chuck, reducing, Z. T. Furbish 666,509
Chuck, supplementary, Z. T. Furbish 666,511
Cigar-box, O. Beese 666,459
Cipher-code system, C. P. Hall 666,520
Clamp. See Routing-machine clamp.
Clock, illuminated, R. R. Gareau 666,381
Cloth-cutting machine, W. Gerhardt 666,513
Cloth, treating machine, D. Gessner 666,382
Clutch, A. G. Sargent 666,563
Clutch, friction, King & Barnhart 666,348
Cock for water or other fluids, self-closing, A. Hansen 666,383
Coffee-pot, T. Babin 666,593
Comminuting machine, G. D. Coleman 666,409
Compressible tube, D. Smith 666,443
Conduit, underground, I. D. Smead 666,361
Consecutive-view apparatus, H. Casler 666,495
Cooking apparatus, steam, M. J. Roach ... 666,357
Cooking feed or scalding hogs, device for, M. M. Johnston 666,273
Cotton-press, steam lever, S. J. Webb 666,294
Coupling. See Car-coupling. Shaft-coupling. Thill-coupling.
Coupling, Krause & Zill 666,531
Crate, knockdown, W. A. Woolsey 666,587
Cream-separator, centrifugal, J. H. Fleming 666,344
Cultivator, R. L. Kerr 666,317
Cultivator, listed-corn, Carpenter & McIlvain 666,494
Curtain-pole, telescopic, J. O. Clark 666,467
Cutter. See Band-cutter. Flue-cutter. Food-cutter. Paper-cutter.
Cutting apparatus, endless, J. A. Wisherd .. 666,298
Cycle driving mechanism, J. Parker 666,548
Delinting-machine, J. Kasmeier 666,384
Die-holder, J. Bradley 666,462
Display-rack for piece goods, A. Olson 666,350
Doors, manufacturing, J. A. Wheeler 666,295
Drier. See Fertilizer-drier. Sardine-drier.
Drying can or cylinder, A. A. Hunting 666,477
Duplicating apparatus, A. B. Dick 666,410
Dye, violet anthracene, O. Bally 666,594
Dyeing with basic dyes, Becke & Bablich ... 666,256
Electric light cord-adjuster, W. C. Tregoning 666,400
Electric motors, construction of, F. A. Johnson 666,315
Electric switch and resistance, C. W. Atkinson 666,255
Electric traction, R. Brown 666,258
Electrotherapeutic apparatus, J. S. Mead ... 666,431
Embossing-die, J. T. Clear 666,468
Engine-exhaust muffler, J. C. Gebhart 666,622
Engine-indicator coupling device, H. D. Bullen 666,407
Engine speed-regulator, explosive, De Dion & Bouton 666,501
Engines, hydrocarbon vaporizer and mixer for explosion, J. C. Gebhart 666,623
Engines, sparkling igniter for explosive, G. L. Reenstierna 666,439
Envelop, R. Rudkin 666,561
Eyeglass-guard, P. J. & W. N. Dachtera ... 666,498
Fabric. See Woven fabric.
Fare-register, W. H. Cooley 666,469, 666,470
Farming implement, E. F. Dickey 666,265
Feed-water of marine boilers, superheating apparatus for, Levi & Radonicich 666,537
Fence machines, clip-feeding mechanism for wire, W. E. Williams 666,402
Fence, wire, W. S. Rowland 666,560
Fender. See Car-fender.
Fertilizer-drier, W. K. Campbell 666,301
Field-glass, &c., coin-operated, J. W. Patterson 666,351
File-cabinet, C. Schroeder 666,359
Filter, T. C. Hefel 666,421
Fire-alarm, W. J. Partridge 666,628
Firearm recoil-cushion, C. B. Shaw 666,564
Firearm, revolving, L. H. Dyer 666,476
Firearm, revolving, F. B. Pope 666,555
Fire-extinguisher, automatic, M. F. Elliott. 666,604
Fish-hook, D. A. Fiege 666,309
Fishing-reel, W. H. Talbot 666,398
Flax-puller, M. Anderson 666,254
Floor, E. Goehst 666,345
Flower made of fur, artificial, C. Hartmann 666,522
Flue-cutter, G. W. Ridler 666,284
Folding box, G. L. Johnstone 666,274
Food-cutter, C. B. Hopkins 666,525
Formaldehyde-vapors, producing, J. J. A. Trillat 666,579
Freezer, C. R. Hamilton 666,269
Furnaces, cinder or hot-metal car for blast, E. A. Weimer 666,447, 666,448
Fuse for firing shells, Buckham & Dardier .. 666,487
Garment-holder, L. M. Marble 666,608
Garment-hook, B. F. Wallace 666,339
Garment, infant's, Schneebeli & Werle 666,286
Gas and steam engine, reversible, Strain & Nicodemus 666,364
Gas burner, hand-lighting acetylene, H. C. Thomson 666,335
Gas-engine, L. F. Burger 666,260
Gas generator, acetylene, T. G. Ames 666,591
Gas generator, acetylene, J. W. Pritchard .. 666,353
Gas generator, acetylene, M. Wagner 666,581
Gas-holder, T. A. Bryan 666,598
Gas, making illuminating, E. R. Besemfelder 666,257
Gate, J. W. Carson 666,376
Glassware, machine for manufacturing blown, C. E. Blue 666,595
Glassware-manufacturing apparatus, A. Humphrey 666,422
Governor, spring-motor, B. G. Royal 666,609
Grain-separator, J. B. Pedrick 666,552
Grave signaling apparatus, M. E. Griffith .. 666,605
Grease-cup, convertible, G. Kirkland 666,318
Grinding-machine, J. Macphail 666,349
Gun-alarm, W. T. Baggett 666,372
Gun-alarm, hammerless, W. T. Baggett 666,405
Hair and fabric clasp, I. G. Kraus 666,532
Handles to files, &c., fixing, J. H. Morgan.. 666,281
Harvester aprons, stretching device for grain, H. J. Case 666,466
Harvester, corn, S. P. Foust 666,380
Hat, apparel, L. Naundorf 666,546
Hat-box, H. L. Perry 666,352
Hat or cap, A. Pedro 666,436
Hat-perforating machine, F. C. Hodshon ... 666,523
Hat-sizing machine, F. Stacy 666,363
Hay-fork trip, J. Patten, Sr 666,551
High and low water alarm, C. E. Zimmermann 666,451
Hitching and unhitching horses, apparatus for, D. C. Fulton 666,506
Horse-detacher for hay-elevators, H. Schwartz 666,287
Horseshoe, H. G. Covey 666,304
Horseshoe-calk, J. R. Williams 666,583
Hose handler or carrier, G. P. De Wolfe ... 666,474
Hose-nozzle, J. P. Van Sickle 666,580
Hose-supporter, R. Gorton 666,515
Hydrocarbon-burner, G. A. Loeben 666,588
Igniter, electric, C. D. Wright 666,618
Index, sliding, W. F. Manry 666,616
Ink-well, H. G. Squires 666,362
Insulator, H. W. Woolbert 666,586
Internal-combustion engine, H. F. Wallmann 666,368
Ironing-board and bench, combined, R. Stahl 666,332
Joint. See Universal joint.
Journal-bearing, O. A. Steutermann 666,570
Kettle or dish cleaner, &c., L. C. Farmer .. 666,433
Kite, C. H. Lamson 666,427
Label-gumming machine, S. B. Tily 666,576
Labeling-machine, C. A. Burt 666,491
Ladder, J. J. Howard 666,526
Ladder, F. S. Seagrave 666,441, 666,442
Ladder for berths, collapsible, W. C. Sherman 666,566
Lamp, electrical glow, A. Couch 666,602
Latch, gate, A. S. Jones 666,425
Leather-working machine, J. Boyle 666,461
Letter-box, street, A. M. Cushing 666,472
Lightning-arrester, W. N. McAnge 666,545
Lightning-arrester, C. A. Rolfe 666,329
Linotype-machine, J. Donegan 666,412
Liquids and beverages, ameliorating and pasteurizing fermented, Lavollay & Bourgoin 666,535
Lock, Burns & Mercer 666,489
Locomotive, J. Player 666,393, 666,394
Locomotive-boiler, J. Player 666,392
Locomotive exhaust mechanism, J. Player .. 666,395
Loom, filling-supply, O. Janelle 666,272
Loom for weaving and cutting pile fabrics, R. L. Hattersley et al 666,270
Loom weft-replenishing mechanism, J. Keith 666,385
Lubricator. See Wheel-lubricator.
Lubricator, M. F. Cox 666,263
Mail-bag closure, Crawford & Bichy 666,613
Malting or drying apparatus, F. H. C. Mey. 666,432
Manure-spreader, J. S. Kemp 666,426
Mattress, A. Battic 666,458
Measuring instrument, electrical, H. P. Ball 666,454
Melter, self-acting, G. Palazzi et al 666,481

(Continued on page 78)

WOOD or METAL Workers



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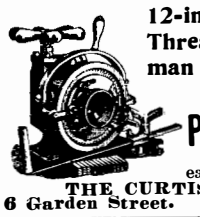

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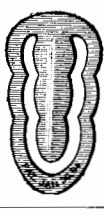

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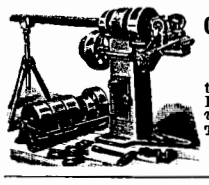

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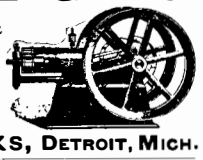

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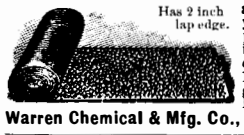

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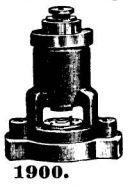

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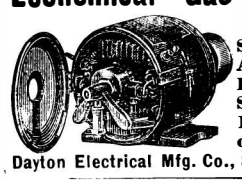

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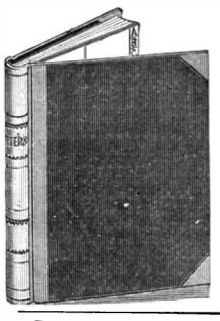

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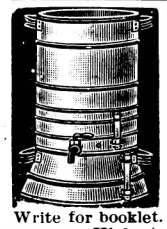

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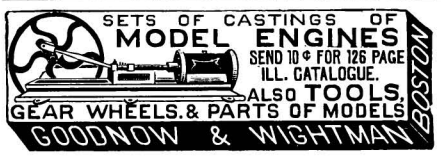

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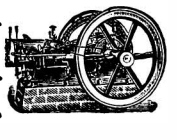

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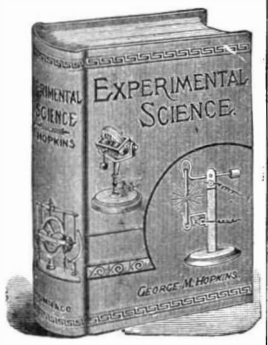

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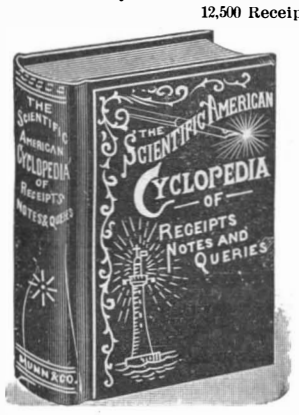

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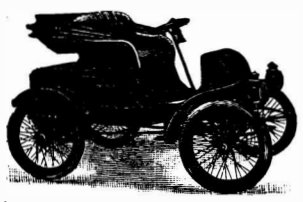

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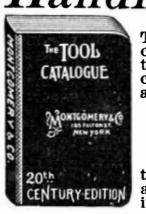

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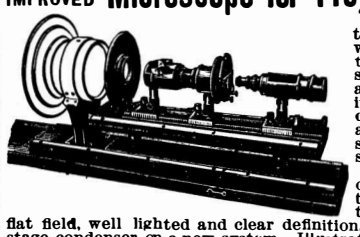

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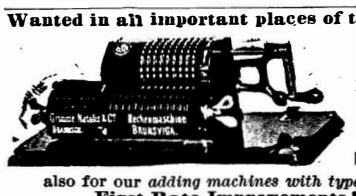

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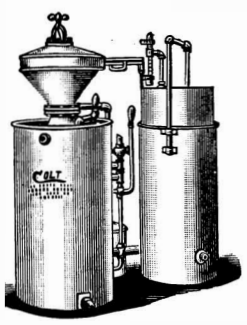

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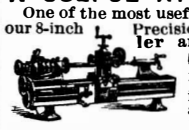

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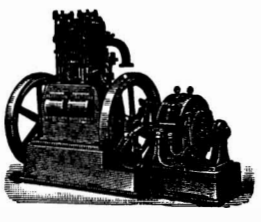

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